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Vol. IX. NEW YORK, MARCH 12, 1887. No. 11.

OUR issue this week contains no fewer than eleven illustrated articles. Its regular and other correspondence will be found of uncommon interest. The articles of Mr. S. D. Field and Messrs. Dann and Lapp will also attract attention.

IF it be true that control of the Baltimore & Ohio Railway system has passed from the hands of Mr. Garrett to those of Mr. Sully, then it is very likely that the telegraph war will come to an end in a compromise on a common rate basis.

THE use of electric power has advanced to the front, and becomes daily more familiar. This week we give some details about the industrial exhibition at Worcester, Mass., to be operated solely by electric motors, and of the street railway system of Montgomery, Ala., all the lines of which are to be worked exclusively by electricity.

THE American Institute of Electrical Engineers does a good thing in devoting its monthly meeting next week to the subject of secondary generators. Discussions of this vital topic are peculiarly timely, and the attendance will naturally be large.

IT is said that the person guilty of tapping "ticker" lines in this city has been detected, and that both the Gold & Stock and Commercial Telegram companies are clear of blame. This will be good news for the friends of both companies, as there has been much bitterness of feeling and accusation on the subject.

IT is well known that persons who have been shocked by a stroke of lightning are ever afterward very sensitive to changes in the electrical conditions of the atmosphere, and hence some practical electrician has suggested that these persons might be utilized by the Weather Bureau as portable electrometers to give indications of coming changes in the state of the weather.

A SHORT note in another column again draws attention to the known fact that the Siemens pyrometer, though admirable in conception, loses its accuracy with continued use, thus making frequent calibration necessary to obtain reliable results. We, therefore, think that some of our readers of an inventive bent of mind might with profit turn their attention to the devising of a trustworthy electrical instrument for the measurement of high temperatures. There are other phenomena besides the one employed in the Siemens instrument which could be applied.

THE field-magnet of the dynamo has been given numerous shapes and dispositions. One of the most recent and unusual is that shown on another page. The inclosure of the wire entirely within the iron was successfully employed by Mr. Eickemeyer several years ago, although only recently brought out by him, and hence others who have subsequently hit upon the same idea have produced similar machines. Thus Professor Forbes showed one of similar design at the Philadelphia Electrical Exhibition, which created considerable interest on account of its enormous current capacity, amounting to some 3,000 ampères.

As long as no separate institution exists devoted to the study and testing of electrical apparatus, we must rely upon our learned institutions for the determination of results which are often of the utmost commercial importance. The facilities which such institutions afford for the study of electricity are constantly increasing, and we can only hope for the time when they will all be able to present to the student a thorough course in electrotechnics, such as some foreign schools provide. Our own institutions, such as the Stevens and Massachusetts Institutes of Technology, Cornell University, and others, have made great advances in this direction, and their facilities, though not complete in every detail, embrace even now sufficient means to furnish a fairly good knowledge of the principal practical applications of electricity.

THE decisions on incandescent lamp litigations in England have followed each other in short order, and it is noteworthy that the decisions of the lower courts are both sustained on appeal. We gave last week a résumé of the points upon which the validity of the Edison patent on the carbon filament was upheld, and now, as already stated by us, the Cheesbrough (Sawyer & Man) patent, held by the same English company, has been sustained on appeal. This patent covers the process of "flashing" filaments in a hydro-carbon gas so as to obtain a uniform brilliancy, by making the carbon of uniform resistance throughout. The defendants in the suit, Messrs. Woodhouse & Rawson, denied the infringment and set up as a defense want of novelty, sustaining it by citing the published experiments of certain French chemists. Chief among these was Despretz, who, it was shown had, in 1849, in attempting to volatilize carbon by means of electricity in an atmosphere of carbureted hydrogen, decomposed that gas and deposited carbon on the block he was attempting to volatilize. Regarding this point, the judges say that before the date of the plaintiff's patent no one had ever intentionally made or attempted to make carbon for any purpose whatever by Despretz's process; and from the evidence it would appear that the carbon so obtained was not shown to be structurally the same as that made by the plaintiffs, nor that that which Despretz got was non-porous. Another point raised by the defendants, namely, that Sidot's method of making carbons was an anticipation of this Sawyer & Man process was also held to be invalid. Sidot's process, which was intended for making arc light carbons, consisted in heating carbon by external means and then depositing carbon on it from a surrounding hydro-carbon gas. And, finally, in regard to the objection raised by the defendants, that the specification of the patent was ambiguous, the judges hold such not to be the case, as the language of the specification they say is clear enough to enable a competent workman to obtain the desired result. Thus on all points brought against it, the patent in question is sustained. A final appeal to the House of Lords is talked of, but has not yet been decided upon. The effects of this decision in conjunction with the one relating to the filament proper cannot but have an important bearing on the incandescent lighting industry in England.

THE recent violent earthquakes in this and other countries where such manifestations have not occurred within the memory of generations, have called attention to the methods in use for detecting and studying such disturbances, to the end that their occurrence and locality of action may be reduced to a regular law. We are as yet remote from the time when it will be possible to foretell the hour and place at which an earthquake will occur, and in this respect the study of other variable natural phenomena, such as the changes in weather, may, by comparison, be considered far advanced. With the exception of Italy, we believe, there is no state in which the movements of the solid crust of the earth are subjected to systematic observation by the government, but there is no reason why others should not join in this work for the good of all. The apparatus required in determining the nature of shocks and time at which they occur forms the subject of an article of which the first part appears in this issue. The instruments are for the most part quite simple in construction and easy of manipulation. Hence with the description given it may be possible for many of our readers to construct them and thus become independent observers. We think the time has come when our own government ought to undertake the observation of earthquake shocks in connection with the weather service. The apparatus required would entail but little expense and would demand a very small part of the attention of weather observers, and we are certain that volunteers would be numerous in aid of this interesting service. As regards the probable origin of earthquake disturbances, it has already been suggested that the relative positions of the sun and moon with respect to the earth may be the cause of their occurrence, or at least an important factor therein. It is even reported that Prof. Rudolph Falb, of Vienna, actually predicted the violent disturbances which recently took place in the Riviera, and that similar past disturbances have been predicted by him with accuracy. He bases his calculations on the relative positions of the earth and the sun and moon, and by applying this theory he is said to have determined that a great flood must have occurred some 4,000 years before Christ, believed by some to be identical with the Biblical deluge; and he predicts the repetition of a like phenomenon in the year A. D. 6400. Whether this general earthquake theory be correct can only be determined by a long series of observations which will be greatly aided by the instruments such as are described in another page.

AN effort was made recently by one of the editors of this journal to give some idea of the actual investment in the electric light business in this country. The task was obviously a difficult one, as all the material for such an estimate had to be carefully collected, while the period of comparison covered about five years. It is now believed that in the main the figures then given, and which have since been quoted the world over, were remarkably near the actuality, and the readiness with which they have been accepted by statisticians of authority is, in fact, notable. The figures were first printed in these columns last January. Since then the Gas Commissioners of Massachusetts have issued their last report, which is, in its way, a strong confirmation of the estimates made as to the investment. At the time of the report of the Commissioners there were 40 electric light companies in Massachusetts in active operation, with an aggregate capital of $3,500,000, and with a capacity of 5,500 arcs and 30,000 incandescents. This capitalization, if applied to the total number of lights burning in the country—about 150,000 arcs and 550,000 incandescents—gives a result of a capital stock value of over $70,000,000 for the *local* arc light business, and over $16,000,000 for the incandescent (including isolated plants in each case). In other words, on such a basis of calculation the figures come out about one-third higher than they were put at before by us on the basis of average cost of the apparatus, etc., and of the real estate necessary for stations and plant room. There is nothing to show that the Massachusetts companies have been extravagantly capitalized, and if allowance be taken for the stock given to parent companies for rights, etc, it will be seen that a very close approximation to the actual facts was made, especially as the holdings of parent companies in sub companies were allowed for in the estimates of the capital value of arc and incandescent *manufacturing* interests. In short, every point that comes to notice goes to prove the immensity and the stability of the investment in electric lighting in this country. Such a record is something electric light men may be proud of, in view of the short space of time in which the industry has been built up. That period embraced some of the worst years of depression ever known in the United States, and the work was made harder by the opposition of the entrenched gas companies. Yet, as has been shown and is plain, the industry with its many allied and collateral interests represents to-day a round sum of $150,000,000.

NEW BOOKS.

DIE ANWENDUNG DER ELEKTRICITAET BEI REGISTRIRENDEN APPARATEN. By Dr. E. Gerland, Vienna, A. Hartleben. 255 pp. Price $1.25. (4 marks).

While registering apparatus were employed as early as the last century to record meteorological phenomena, it is in but comparatively recent times that their great value has been recognized and their employment generally introduced with success in the sciences and arts. To-day the larger part of such apparatus is based upon electrical action, the instantaneous effect of the current at a distance, and its convenience of use making it the method *par excellence*.

The author has divided the subject under treatment into four chapters. In the first he takes up astronomical apparatus of this class embodied principally in what are called chronographs, by which accurate time is transmitted from one station to another, and used extensively in the time-ball service. The time of passage of the heavenly bodies over the meridian is also registered by this class of apparatus, and the determination of the difference in longitude between two stations is also one of its important functions. The apparatus designed for this purpose by Siemens and Halske, Krille, Hipp and others is fully described and illustrated.

The technical and physical registering instruments form the subject of the second chapter, and in this are included apparatus for measuring small intervals of time, and the velocity of projectiles. Then follows a description of electrical speed indicators and registers of mechanical work. Special attention is also given to instruments for registering electrical work, both with constant current and with constant potential.

Chapter IV. treats of the various apparatus for meteorological observation, the various registering thermometers, barometers, etc.

The concluding chapter is a résumé of the principal forms of apparatus designed to register the changes which take place on the surface of the earth, both as regards the solid crust and the fluid portion. This includes the instruments for registering the rise and fall of rivers and the tides, and seismographs which indicate the vibrations due to earthquakes; finally, earth-current registers are also described.

Apparatus of the nature treated of in the book is becoming so general, and is so useful that a general treatise regarding its nature and functious as here given cannot fail to interest the reader, especially if his line of work is in one of the departments considered. The book is well illustrated throughout.

The Theory of Self-Regulating Motors.

To the Editor of The Electrical World:

SIR: I have heard of a man who brought to a trotting match a fine high-stepping mare which had been entered in his name, when a curious incident arose. Some of the spectators, recognizing the creature, pointed out that the individual who had entered the mare for the running had merely borrowed her for the occasion. Thereupon the individual in question, without denying the fact, offered to the bystanders (among whom were the owners of the animal) to bet a thousand dollars all round that she would lick all creation for speed.

I was reminded of this narrative by reading Mr. Sprague's somewhat amusing challenge about the motors, which appeared in your issue of February 12. As Mr. Sprague, for whom I have the highest personal and professional regard, has done me the honor of mentioning my name in his "challenge," he will pardon my reference to the facts of the case. This is necessary because he has made a mistake and challenged on the wrong issue. If I had said that his motors of 1886 were no better built than those made in Europe in 1882, his challenge to build better motors might have been in place. The matter in dispute is a matter of principie, not of construction; it will be time enough to challenge construction when the goodness of that construction is doubted. What are the facts?

In 1882, a date at which Mr. Sprague was, I believe, in England, Professors Ayrton and Perry patented the regulation of motors by the process of using a *differential shunt and series winding;* they also enunciated in that year and the year following the mathematical theory of this kind of winding. That theory I expounded and developed in my work on "Dynamo-Electric Machinery," published in August, 1884.

In THE ELECTRICAL WORLD for October 16, 1886, there appeared an extremely able, but anonymous, article on Mr. Sprague's researches upon motors, which described a number of excellent forms of motors, and also entered into the theory of motor regulation. In this paper—and probably Mr. Sprague can say whether the statement is true—it is stated that in the self-regulating forms of the Sprague motors a differential shunt and series winding is also used. The article further gave a certain equation as "the Sprague law of winding," and that equation is mathematically identical with one of the equations (No. LIV.) given in my book. When I read this article, in justice to Professors Ayrton and Perry, I pointed out that "the Sprague law of winding" was simply identical with the Ayrton and Perry law of winding. Professors Ayrton and Perry also noted the point. So did my friend Mr. W. Mordey, whose experience and authority on motor matters are well known, and he poked a little quiet fun at Mr. Sprague, condoling with him on the misfortune that he had patented what was previously well known.

What does Mr. Sprague do? I have read and re-read his letter. I do not find therein that he denies either that he uses a differential shunt and series winding, or that the theory of motor regulation by means of the differential shunt and series winding was given in 1882 by Ayrton and Perry. Does he deny either of these points? On the contrary, he poses with a high-flown theatrical challenge to all comers to build a motor that will equal the one that he will build; and he even names the umpires for the contest! That extravagant display of courage will not alter the facts. It is the facts that are the real issue, not the performance of the machine. Does Mr. Sprague wish to hide the real issue by inviting an expensive competition to try issues that are wholly irrelevant? His umpires can tell him, at much less expense, whether the Sprague law of winding is different from the Ayrton and Perry law of winding. Why then build the motors?

I cannot speak either for Professors Ayrton and Perry, or for Mr. Mordey, but I greatly doubt whether they will accept a challenge on the wrong issue. What are the two umpires to decide? Which motor runs coolest? Which motor develops most horse-power per pound weight? Which motor has the highest economical efficiency? Which motor gives the best regulation under all sorts of loads? No man in his senses will enter into a competition before he knows what is the issue to be competed for. The real issue is indeed none of these things. It is not whether Mr. Sprague's motors are better designed than Mr. Mordey's, or whether they are better designed than those of Professors Ayrton and Perry. The real issue is this: Has Mr. Sprague any right to claim or to use *the differential shunt and series winding* which was invented, described and claimed by Professors Ayrton and Perry in 1882? Other issues are only secondary.

Perhaps I do Mr. Sprague an injustice by concluding, on the strength of the anonymous article in THE ELECTRICAL WORLD, that he does claim or use this principle. If he does not claim or use it, there is an end of the matter; there is nothing left to contest. But if it is true that the Sprague mare has been borrowed from the Ayrton and Perry stable, then no amount of betting that she will lick all creation is of the smallest use. If she beats every other creature on the earth *that will not prove that she was not borrowed.*

I regret much that Mr. Sprague's letter compels me to write so plainly. I remember well his earlier motors at the Philadelphia Exhibition. They were one of its best features. I congratulated him at the time on their ingenuity and on their good design and performance. I congratulate him on the progress he has since made. I wish him fame and fortune. But I am not going to let him call Ayrton and Perry's theory of self-regulating motors the Sprague theory without protesting politely, but firmly, that it is not his.

SILVANUS P. THOMPSON.

CITY AND GUILDS' TECHNICAL COLLEGE,
FINSBURY, LONDON, Feb. 21, 1887.

Cable Electricians.

To the Editor of The Electrical World:

SIR: In your issue of Jan. 8, page 23, I notice a paragraph under "Personals," respecting that very able electrician, Mr. Herbert Kingsford, M. S. T. E. I think he will not feel flattered by the mention of his name in connection with the cable repairing steamer "Mackay-Bennett," and the entire suppression of his long service in this ship—we are quite aware that the Commercial Cable Company keep themselves well advertised in the New York *Herald*, and that from time to time the officers of that company appear prominently in print. We have also seen well advertised the liberality of that company to its officers on the two anniversaries of its existence. We quite understand the value of advertising. *Did its liberality on those occasions reach the able officers they took from my ship, and after a few short months cast adrift?*

I do not wish to detract from the value or ability of the officers of the Commercial Cable Company; they are old friends, and were most of them drawn from this company's and the Direct company's service. The Anglo Company has been the cradle and nursery of nearly all the officers and staff of every opposition Atlantic cable company. It may be that at times there is a little rivalry between us, but the bonds of friendship are as strong as ever, and we are pleased and proud of their advancement. We do, however, strongly object to the Mackay-Bennett Company laying any claim to Mr. Herbert Kingsford. He, like ourselves, is an old "Anglo," and he is still associated with myself and Mr. F. A. Hamilton, the chief electrican of this ship, and jointly owns with us some valuable patents in connection with submarine telegraphy. The Central and South American Telegraph Company were very fortunate in securing the services of such an able and experienced electrical engineer, and I have been pleased to learn that the President, Mr. J. A. Scrymser, fully appreciates his worth.

We do not, Mr. Editor, often rush into print, *we are too modest*, but we must remind our old friends that the Anglo-American Telegraph Company, Limited, exists, and that it still has a number of officers and a staff, who, in their different spheres, are second to none, while some of them have never been equaled in the annals of submarine telegraphy.

I also note in your paper of same date, page 21, while referring to the death of Mr. Frederick Davies, it is stated: "Twenty years ago, when Sir James Anderson laid the first Atlantic cable, young Frederick Davies, a native of Wales, was one of the young electricians who accompanied this eventful expedition in its experiment across the vast deep. After the completion of the work Mr. Davies was stationed at Valentia for a considerable time as electrician in charge. He also, under the direction of James B. Stearns, carried into practical effect the duplex system of cables."

By referring to *The Telegraphist* of London for Jan. 1, 1886, in which is a brief outline of the life of Mr. James Graves, I select the following passages from page 17: "And by a mutual arrangement, Mr. Graves was sent by the Electric and International Telegraph Company to the Atlantic Telegraph Company to act as Mr. Varley's representative at Greenwich during its manufacture and shipment, * * * from the 24th of May, 1864, whereupon Mr. Graves took up his residence in Greenwich. This work having been performed throughout to the satisfaction of the board of directors of the Electric Telegraph Company, Mr. Graves was by them appointed to the superintendence of their Valentia station on the 25th of June, 1865, * * * and in which position he was transferred on the 27th of July, 1866, to the Anglo-American Telegraph Company." Again: "For several months Mr. Graves assisted Mr. J. B. Stearns in his protracted experiments, with a view to adapt his duplex system to Atlantic cables, in which they were finally successful, and it has been applied by Mr. Graves to all the Atlantic cables subsequently laid, and worked from Valentia station."

As Mr. Graves is the only electrician who has been in charge of the station at Valentia, and still holds that position, I am sure you will, in justice to that gentleman, correct what is evidently a misstatement, and which, had Mr. Davies been living, he doubtless would have been the first to correct.

SAMUEL TROTT, Captain S. S. "Mhia."

HALIFAX, N. S., Feb. 27, 1887.

[Our intention in speaking briefly of Mr. Kingsford's more recent work was not to give his life career but to compliment him, as he deserved, upon one of his latest achievements. This is evident, even to any one reading the note hurriedly. No doubt Mr. Kingsford is proud of his whole record. We have nothing to do with the jealousies between the cable companies or their methods of advertising, and the only criticisms that have appeared in our columns on the subject relate to their public policy, not to their *personnel*. What Capt. Trott, himself a well-known pioneer, says regarding the position of the old Anglo company, as a cradle and nursery, is quite true and is not forgotten by us. Respecting Mr. Davies, we would point out that our New York correspondent's note referring to him was supplemented by another note in the issue of Jan. 15, giving fuller and more accurate details of his life. —EDS. E. W.]

The Early Days of the Telegraph.

To the Editor of The Electrical World:

SIR: Among an interesting collection of old papers recently placed in my hands by my friend, Rodolphus Edwards, is a copy of the Cleveland Daily *Herald* for April 7, 1845. Of its 28 columns, 23 are given up to advertisements. The remaining five columns contain editorial miscellany, a communication of intense interest entitled "Plank Roads—What shall be done?", clippings from exchanges, etc. An account of the Rhode Island state election held on the 2d inst. closes with the information that the majority for the gubernatorial candidate for re-election "at Providence at 12 o'clock on the day of election was 219. A heavy vote was polled. *No other returns.*"

The telegraphic news seems to have been received by the Packet Line and is limited to the following article. I send the clipping entire, as it constitutes the chief incentive for sending you this communication:

"ELECTRO-MAGNETIC TELEGRAPH.—The electro-magnetic telegraph between Baltimore and Washington is now a branch of the mail service and under the control of the General Post Office Department. Prof. Morse, his Assistant superintendents, H. J. Rogers and A. Vail, and all others in any way connected with the telegraph, have taken the oath of office, and the telegraph office in Baltimore is to be removed to the post office building. Office at Baltimore to be under the superintendence of Mr. Rogers, and the one in Washington under the management of Mr. Vail. Office open during business hours every day except Sunday. The Baltimore *American* states on reliable authority that books will be opened in a few days in New York, Philadelphia, Baltimore and Washington for subscription to the stock of a company for the construction of a line of Morse's magnetic telegraphs between Baltimore and New York, with Amos Kendall at its head.

"The following extract from the orders of the Postmaster-General to Prof. Morse will fully explain the plan to be pursued in telegraphing hereafter: 'For the transmission of each dispatch there shall be paid in advance, at the office from which it is sent by the applicant, one-quarter of one cent for each telegraphic character or letter. Upon the reception of a dispatch at either office, it shall be the duty of the officers to have the same translated in a fair handwriting, carefully enveloped and sealed, and the magnetic characters immediately destroyed, and to place the dispatch in the hands of the penny post for

delivery, who shall be entitled to receive the same compensation therefor as for the delivery of letters transmitted now by mail. It is further ordered that the said superintendent and assistants in no case communicate to, or permit to be seen by any person, the contents of any despatch except the individual or individuals to whom it may be addressed.'"

ELROY M. AVERY.

CLEVELAND, O., Feb. 28.

Studying Earthquakes by Electricity.

The study of earthquakes is one of those venerable and worthy candidates that has been waiting for centuries to be assigned its position in the hierarchy of science. This long neglect has not been due to a lack of interest in the various mysterious phenomena of earthquakes. On the contrary, the world of science has always regarded these phenomena as wonders possessed of the greatest interest, on account of the important revelations which they can doubtless make respecting the history—past, present and future—of our universe. Unfortunately they speak in a language which science could never interpret; and they have of necessity remained a sealed book until the present time, when the vocabulary of human knowledge, after having been developed by culture in other directions, can help us to understand their meaning, at least in part. In a word, it was necessary that other departments of research should, through their own progress, indicate methods whereby the study of phenomena so strange and so difficult to follow could be begun. The study of other natural phenomena, notably those of the weather, has done much to point out the way in which science is now preparing to study earthquakes.

The weather was at first as perplexing and hopeless a study as earthquakes now seem to be. For years the clerk of the weather, or "Old Prob.," as that mythical "professor of atmospheric influences" is familiarly called, had to content himself with the recording of observations apparently isolated and having no relationship. He noted the changes of temperature, atmospheric pressure, the direction and severity of winds, rain or snow storms, the variations of the magnetic needle, etc., without knowing the connection between these phenomena. But in time the accumulation of such data, when subjected to careful comparison and analysis, revealed evidences of affinity between phenomena of one class and others of a different class. Thus, from the study of effects and their comparison with each other to discover concomitant conditions, certain laws have been traced, and a science has been developed which enables "Old Prob." to "scent the breeze afar," and he can trace beforehand the course of the storm from the sea, or the path of a cold wave from Manitoba through the length and breadth of the land, with almost unerring certainty and precision. The science of seismology, then, can not only learn from that of meteorology the secret of a valuable method of study, but it can obtain also many useful data for comparison and analysis. Indeed, this science is largely dependent upon the assistance which the weather department can render. In the south of Europe, where earthquakes are so frequent as to be considered elements of the "weather," their study is in charge of the weather department. If ever they become "fashionable" in this country, as the recent shakes in Charleston would promise, "Old Prob." will no doubt find himself obliged to cultivate another accomplishment.

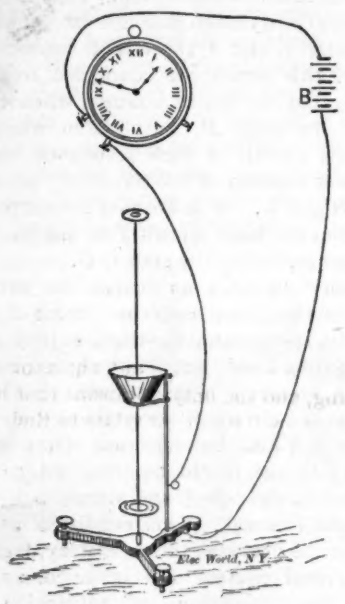
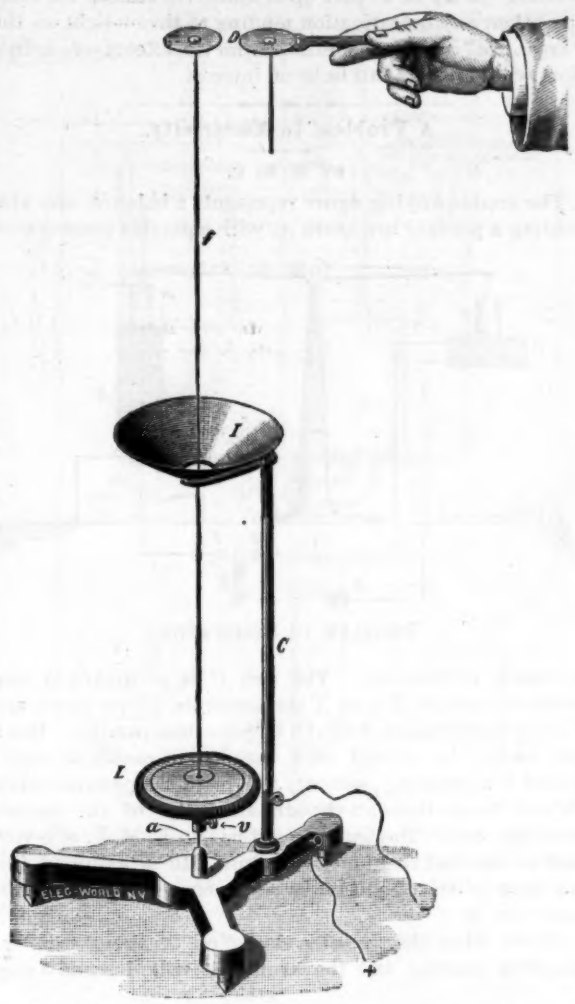


FIG. 3.

Earthquakes generally occur at various places simultaneously. They seem to involve a certain portion of country which has been called the earthquake area. The shocks are supposed to have certain connection with other phenomena or conditions of nature which obtain at or about the same time.

It is well known, for instance, that the shocks occur more frequently at night. It appears also that they are more likely to occur in certain months—September being considered a favorite month. Other astronomical conditions are supposed to coincide, such as the time when the combined attraction of the sun and moon on the earth is greatest, or the years when the sun spots are most numerous. The weather is supposed to give evidence of the presence of earthquake disturbances by disclosing peculiar conditions of atmospheric pressure, great calm or high winds, floods or drought, while electrical and magnetic disturbances are likewise noticeable. Finally, it is supposed that volcanoes have a certain relationship to earthquakes. Therefore, it is clear that the method of association of phenomena will lead to important knowledge, if



FIGS. 1 AND 2.—THE DISC SEISMOSCOPE.

by means of suitable apparatus the earthquake shocks are not only made to record the time at which they occur, but also their direction and their intensity. This may be accomplished by comparatively simple means with the help of electricity, as will be seen from the subjoined details and illustrations, which give an idea of the apparatus constructed by Brassart Brothers, of Rome, and used by the Italian Meteorological Office, under whose auspices seismology may indeed be said to have first attained the dignity of a science.

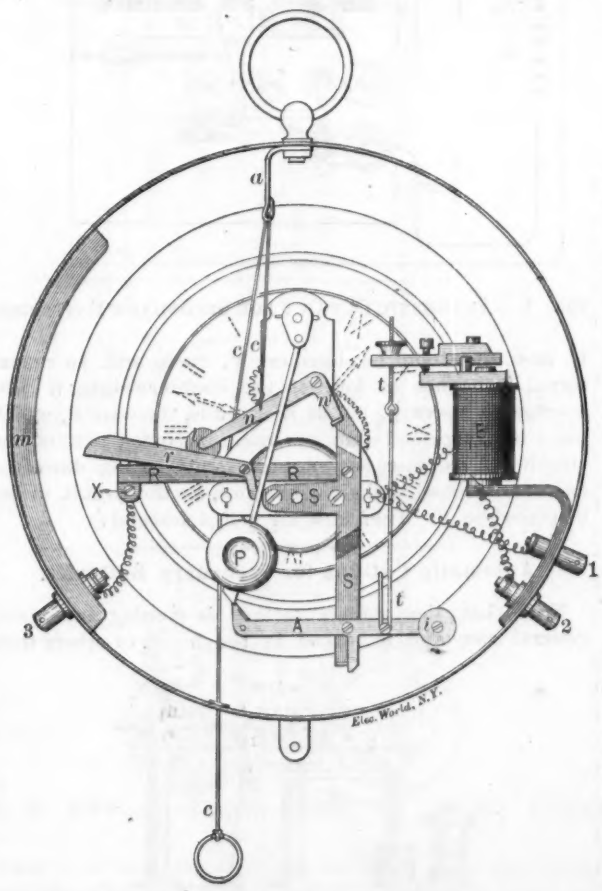


FIG. 5.—SEISMOSCOPE CLOCK.

The instances are numerous where electricity renders most valuable services by playing what seems the humblest rôle. And yet, if we stop to consider, we realize the complication in, if not the impossibility of, arriving at the same results by other means. This is such an instance; earthquake shocks, as is well known, follow no conventionalities of time or place. They are features which, unlike eclipses, comets and other features of the great cosmic "show," cannot be advertised beforehand. They come and go on "surprise," and the most vigilant of observers might be caught napping. Yet a simple electrical circuit and a few equally simple devices are all that is needed to make the shock announce and even record itself.

The Italians have already distinguished three distinct kinds of earthquake movements—namely, subsultory, undulatory and whirling. The first, which might also be termed vertical, exhibit the character of upheavals, such as a mine exploded immediately under the surface might produce. The second are rocking movements which proceed in one direction like waves of water, or else in somewhat concentric lines; the centre of the circle thus described being then presumed to be the seat of a subsultory or vertical disturbance. The third form, or whirling earthquake, exhibits a peculiar tornado-like rotation, as if it were the result of simultaneous opposing movements. This last form is the most destructive earthquake disturbance. Fortunately its occurrence is so rare that the first two forms are the only ones usually considered.

One of the simplest forms of apparatus used is that known as the disc seismoscope shown in Fig. 1. Supported on a cast-iron tripod, but insulated from it by an ebonite bushing, is a brass rod *C*, whose upper extremity is provided with an arm holding the brass funnel-shaped piece *I*. A fine steel wire *f*, about one mm. in diameter and 35 cm. in length, is secured to the centre of this tripod and rises vertically from it, passing through the centre of the opening in funnel *I*. A flattened, or lentil-shaped weight *L*, of about 200 grammes, slides on the wire *f*, and by means of the set screw *v* can be secured to it at any part of its length. It is usually set at a short distance above the tripod, so as to leave the wire free for a space *a* of five to seven mm.

Owing to the inertia of this weight, the effect of any

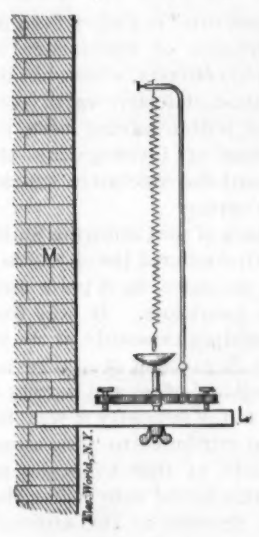


FIG. 4.

vibration communicated from the ground to the tripod of the instrument is to make the wire yield at the portion *a*; and as the wire immediately tends to straighten itself by virtue of its elasticity, it results that the whole portion of wire above the weight makes a pendulum-like movement by which the original vibration is greatly amplified. The slightest vibration, therefore, will cause the small brass disc which is balanced on the upper end of the wire to topple and fall down. The disc is rendered all the more sensitive to these vibrations by having its central part made of glass; while the upper end of the wire on which it is balanced is itself rounded off and well polished. It would at first seem impossible to balance such a disc on what is almost a single point. To facilitate this operation the exact centre of gravity of the disc is indicated by a small circle cut in the glass. By means of small tweezers (Fig. 2) the disc is then gently placed over the end of the wire, which can be seen through the glass from above. As long as the wire is absolutely still the disc will remain in position, and this for months, even though the wire is not exactly vertical. But the most minute vibration will cause its fall. Indeed, this instrument is so sensitive that, when placed upon an ordinary table, the vibration caused by a person walking across the floor may suffice to make the disc drop. For this reason great care is taken to isolate all seismoscopic apparatus from such accidental disturbances, and these instruments are usually placed upon stone or marble shelves, which are securely wedged in the walls of the building or other masonry (Fig. 4).

The tripod is connected with one of the wires of an electrical circuit, while the arm *C* is connected with the other. When the disc falls, it is stopped by the funnel *I*, whose sloping walls cause it to run against the wire, whereupon the electrical circuit is closed and any desired device may be operated. Sometimes this circuit includes only an alarm bell to notify the attendant of the occurrence of a shock. Usually the circuit includes a clock, Fig. 3, because the exact time at which the disturbance occurred can then be determined. The clock may be either one that *stops* or one that *starts* when the circuit is closed. The latter form is preferred, for the evident reason that it need not be looked after during the intervals between shocks, oftentimes long. This clock, Fig. 5, is of ordinary construction, with such parts added as are

necessary to render it adaptable to these purposes. In the figure, which is a rear view of the clock, the shaded parts represent these accessory devices, the rest being merely outlined. The clock is shown with the pendulum *P* inclined well to the left, in which position it is detained by the beveled end of the rocking lever *A*, pivoted to the brass frame extension *S S*. The lever *A* is held in the path of the pendulum *P* by a counterweight *i*. This weight serves at the same time to retract the armature of the electro-magnet *E*, which is connected to the lever *A* by the wire *t t*. When any impulse of current passes through the electro-magnet *E*, the attraction of the armature pulls the wire *t t*, the lever *A* is tilted out of the path of the pendulum and the clock begins to run. As the pendulum does not normally swing back far enough to come against the beveled shoe on the lever *A*, the clock will continue to run. The bell crank lever *r*, which was held to the left by the inclination of the pendulum, now falls down of its own weight and closes a local circuit at *X*. This local circuit usually serves to operate an alarm bell, which continues to ring until the clock is again stopped. The attendant does this by pulling the string *c c c*, which lifts up the long arm *n* of a bell crank lever whose short arm *n'* has its extremity bent outward. This bent portion is swung against the pendulum and forces it back to the position shown in the figure. The counterweight *i* causes the lever *n n'* to resume its normal position when the string is released. In practice the clock is always set with its hands at the hour of twelve when it is stopped.

The time at which the disturbance occurred is then indicated by the number of hours, minutes or seconds which elapsed before the attendant arrived.

(To be continued.)

Cross-Fire on Electrical Circuits.

BY STEPHEN D. FIELD.

The term "cross-fire" has often been used to designate a peculiar disturbance or reactionary effect noticed on parallel telegraphic circuits, which has been attributed to imperfect insulation, defective earth connections, and to induction. The writer having been peculiarly favored with opportunities of investigating this phenomenon, ventures to present the conclusion which he has arrived at regarding its nature.

In the early days of the California State Telegraph Company, but two wires entered the city of San Francisco, both being strung on the same set of poles and insulated therefrom by Wade insulators. It was found impossible to work these wires simultaneously at all times during the dry season, for a distance of even fifty miles. After exhausting all possible devices and battery arrangements for the elimination of the difficulty it was finally set down as "cross-fire," and attributed to "the climate."

Mr. Geo. S. Ladd, at that time the superintendent of the company, came to the conclusion that notwithstanding the extreme dryness of the atmosphere, the trouble was leakage, and he placed ground wires on every pole for the first 25 miles out from San Francisco, the effect of which was to immediately remedy the difficulty.

An inspection of similar trouble in other parts of the territory covered by the company showed it to be of the same origin. The amount of interference seemed to be about the same whether 50 or 400 miles of wire ran parallel; that is, by opening one of two 400 mile circuits fifty miles from a terminal station, the "cross-fire" from the other would be nearly as heavy as when both circuits were complete.

Recent experiments in induction have brought these facts back to my mind and give rise to the thought that perhaps many of the present telephone troubles called induction may be nothing but leakage. Persons versed in hydraulics know the immense strain brought upon a pipe by suddenly shutting off a stream of water under pressure, a feature utilized in an apparatus called the hydraulic ram. Why may we not have a similar phenomenon in electricity? Why does not the breaking of a long line charged with electricity in motion cause a sudden tension upon the insulators? And why may we not consider electricity as a fluid and incompressible?

If we assume such to be the case the explanation of the cross-fire phenomenon can be made complete, and for the following reasons:

1. Cross-fire is greatest when the pole resistance to earth is the greatest, that is, on a hot, dry day. 2. It appears on sections of line far too short to admit of inductive discharge being accepted as the explanation. 3. It gives the most trouble when but few wires are on the poles and can in most cases be eliminated by good earth connections on every cross arm. 4. When many wires are on the poles the disturbance seems to adjust itself by division among them all, not enough appearing in any one to occasion a serious interruption to the working.

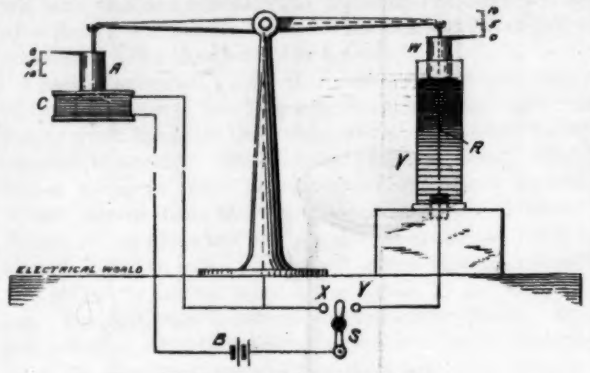
One test made in California showed a bad sympathy between two circuits on the same supports, one wire being open three miles from San Francisco, while the other was being used as a through wire to Sacramento, 150 miles distant. A steady current on the active circuit was not apparent on the shorter one; but every pulsation of current on the active circuit was followed by a sharp click of the relay on the idle or shorter line. The short line discharge was of the same nature, but of infinitely greater amount than would have been obtained from a condenser having the same capacity as the surface exposed on the line, and its removal by the use of grounded supports would seem to indicate that induction was not its cause.

Many readers of THE ELECTRICAL WORLD no doubt have rare opportunities of further investigation of this phenomena, and in view of the wide introduction in electric lighting and telephonic installations of apparatus depending wholly or in part upon inductive effects for their operation, any investigation tending to throw light on the "cross-fire" and its separation from the effects of induction, would hardly fail to be of interest.

A Problem in Electricity.

BY H. M. E.

The accompanying figure represents a balance, one arm bearing a plunger armature *A*, with a pointer passing over



PROBLEM IN RESISTANCE.

a scale in millimetres. The coil *C* is so arranged that when the switch *S* is on *X* the armature moves down uniformly 1 millimetre for each ampère then passing. But if the switch be moved on Y the current passes through a vessel *V* containing mercury, through the counterweight *W* and thence through the arm and pillar of the balance into the coil. The battery used has an E. M. F. of 5 volts and an internal resistance of 1 ohm. It is assumed that no part of the circuit offers resistance except the battery and wire *R*.

Hence when the circuit is closed on *X* there will be 5 ampères passing and the armature will descend 5 mm.

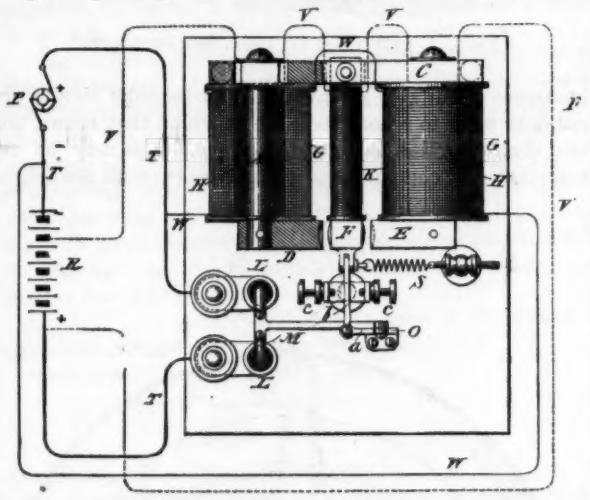


FIG. 1.—AUTOMATIC CUT-OUT FOR SECONDARY BATTERIES.

If, now, the circuit be closed on *Y*, there will be no external resistance as long as the counterweight *W* *just touches the mercury*, but as *W* ascends, the wire *R*, which has a resistance of 1 ohm per mm., becomes part of the circuit and increases the total resistance cutting down the current. Knowing these conditions, let the circuit closer be placed on *Y*. Then how far will *A* descend?

Automatic Cut-Out for Secondary Batteries.

Now that the storage battery is coming into more general use, and is placed in the hands of others than

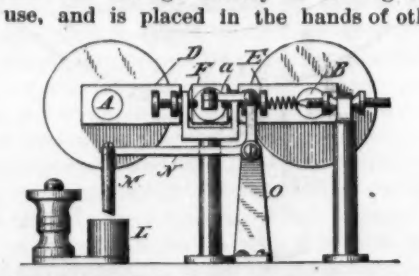


FIG. 2.—AUTOMATIC CUT-OUT FOR SECONDARY BATTERIES.

electricians, a reliable instrument for automatically switching the battery in and out when the conditions of its working require it, is of considerable value. Such an automatic switch has been designed by Mr. George B. Prescott, Jr., of Newark, N. J. It appears to be eminently suited to the purpose. The arrangement may be said, in general terms, to comprise a branched circuit from a dynamo machine, in one branch of which is the secondary battery and the circuit-breaker, and in the other, which is of high resistance, is the magnet which controls the circuit-breaker in the first circuit. A certain force opposes the magnetizing effect of the high resistance branch. A part of this opposition is in a spring; but for the successful operation of the device it is necessary to have, in addition to this, a varying force, which exerts itself by neutralizing the effect of a branch circuit. This is attained by the use of a differential magnet, one of the circuits of which is a branch and the other a circuit including a portion of the secondary battery. The armature, to secure greater sensitiveness and a positive action in both directions, is polarized; and, instead of using a permanent or other magnet to polarize it, it is itself made a magnet, the secondary battery circuit being, for convenience, utilized for this purpose.

In the accompanying illustrations, Fig. 1 is a plan and part sectional view of the apparatus, with a diagram of the circuit connections; and Fig. 2 is an end view of the cut-out mechanism. *A* and *B* are cores of an electro-magnet secured to the cross-bar *C*. These cores have pole-pieces *D E*, between which is located a soft iron armature *F*, pivoted to the bar *C*. Each of the cores *A B* is wound with two coils *G H*, superposed upon each other. The outer coil contains a greater number of layers, in order to balance its magnetizing effect as compared with the inner coil. The armature *F* is also surrounded by a coil *K*.

The mercury cups *L L* are joined by a copper yoke *M*, carried at the end of a bell-crank lever *N*, pivoted to a standard *O*. This lever is connected with the armature *F*, so that the lateral movement of the armature will raise or lower the yoke *M* and thereby connect or disconnect the mercury cups *L L*. A simple form of connection is shown in the two links *a* and *b*, connected to the end of the lever *N* and of the armature, respectively. Adjustable stops *c* are placed on opposite sides of the link *b* to limit the movement and prevent the armature from touching the poles of the magnet. A spring *S* is connected to the armature and tends to hold it in the position in which it raises the yoke *M* and disconnects the mercury cups *L L*.

P represents the dynamo machine or generator, *R* the secondary battery, and *T* the circuit connecting the two. The wires of this circuit are connected to the mercury cups *L L*, so that the circuit is closed when the cups are spanned by the yoke *M*, but broken when the yoke is raised. *V* is a circuit of high resistance, including less than the whole number of the secondary battery cells and the coils *H H* and *K*. *W* is another circuit of high resistance, run from the main circuit *T* on opposite sides of the generator and including the coils *G G*.

If the battery contains no charge, the armature *F* is drawn over by the spring and the circuit *T* interrupted. On starting up the dynamo for the first time the circuit *T* must be closed by hand; but if any charge remains in the battery the armature *F* is magnetized. As soon, then, as the current in the circuit *W* overcomes the magnetizing effect of circuit *V* and the resistance of the spring *S*, the armature, which has, it will be supposed, a north polarity, is repelled by the pole *E* and attracted by the pole *D*, and the circuit *T* closed. This condition of things continues during the charging of the battery, but may be reversed by several causes. For instance, as the battery approaches the condition of saturation the relatively greater amount of current which passes through the circuit *V*, as compared with that in circuit *W*, neutralizes the effect of the latter until a point is reached at which, with the assistance of the spring *S*, the armature is drawn over and circuit *T* broken. On the other hand, if the speed of the machine should slacken, or its electromotive force for any reason should fall below that of the battery, the proportion of current that passes through circuit *V*, with the aid of the spring, neutralizes the effect of the circuit *W*, and the battery is instantly disconnected from the machine. Should the machine stop, the current in circuit *W* practically ceases, so that the cut-out operates instantly.

For the proper operation of the device, it is necessary to adjust or balance the resistances and magnetizing effects of the coils *G H*, so that the former will have sufficient effect to neutralize the other and to disconnect the battery whenever the electromotive force of the battery equals or exceeds that of the machine or approaches it to a certain predetermined limit. This is accomplished by placing the coils *H* nearer the core than the coils *G*, or by making the coils *H* with a greater number of turns.

The Electric Pyrometer.

At the Sèvres porcelain works the temperature of the kilns is usually ascertained by the aid of Siemens' electric pyrometer. Most of our readers, says the London *Electrician*, will be aware that this apparatus consists of a coil of platinum wire, which is placed in the furnace, the temperature of which is then ascertained by measuring the resistance of the coil, and comparing the result with a table of temperature. Unfortunately, M. Lanth, managing director of the works at Sèvres, and M. Vogt, the chief of the chemical department, have ascertained that the indications of temperature obtained by this method are by no means of a reliable character. Two pyrometers which at first agree are found after a few weeks' service to give very divergent results. This is evidently due to a variation in the electrical resistance of platinum following some molecular change consequent on the high temperature to which the metal is exposed. The subject being one of considerable interest to the porcelain industry, the hope is expressed that some one will shortly succeed in discovering an alloy capable of giving better results in this direction.

Recent Improvements in the Regulation of Heat by Electrical and Mechanical Contrivances.

BY ROBERT H. ENGLE.

For some years past the subject of artificial incubation has occupied the attention of Mr. Henry B. Tatham, Jr., of Philadelphia, and as the *sine qua non* of success in this direction lies in the maintenance of an equable temperature, the study of heat regulation has naturally formed a part of his work. The results of his experiments are embodied in a number of heat regulators, both electrical and mechanical, a few of which I propose to describe, as they concern some novel and interesting points.

Of the regulators seen in the accompanying illustrations, Fig. 1 is the simplest form of apparatus, but requires a constant battery. With those shown in Figs. 2 and 3, owing to the arrangement of circuit-breakers, open circuit batteries can be used; while that shown in Fig. 4 is non-electric, depending for its action upon the expansion and contraction of a bar of hard rubber.

In running incubators or chemical apparatus where a water supply is not handy, a barrel or other vessel filled with water is placed at an elevation, which, in many cases, will be sufficient for a week or more, a bell ringing when the supply becomes low.

The apparatus shown in Fig. 1 consists of a small tank which receives a constant supply of water from any suitable source through the upper valve V controlled by the float F' and lever L in connection therewith. This lever is longitudinally divided through its centre to permit of the passage of the stem S from the lower valve V' to the electro-magnet E above, which operates the same, and also the rod from the lower float F' to the working beam B above, from which are made the damper attachments.

The thermostat T, found to be most suitable, is a combined bar of steel and ebonite, their co-efficients of expansion being unlike, ebonite expanding about eight times as much as steel. One circuit of the thermostat is connected with the tank and the other with an electric bell.

The illustration represents the apparatus in its normal position. The thermostatic bar having completed neither circuit, the armature upon the magnet consequently remains elevated by the spring on the valve stem, which balances the weight of water on the valve V' and maintains

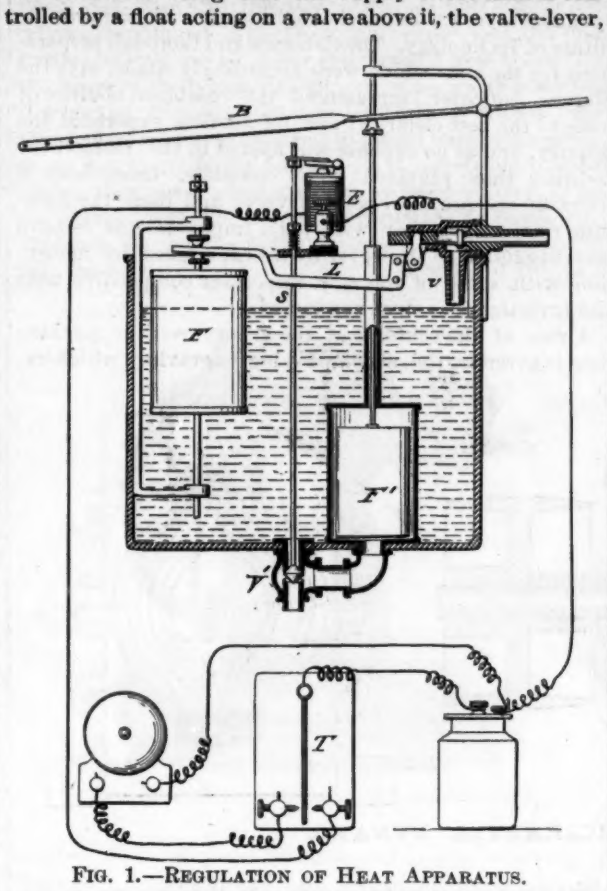


FIG. 1.—REGULATION OF HEAT APPARATUS.

the same in contact with its upper seat. This prevents the flow of water to the lower float-casing, the float and beam above, therefore, being down and the damper closed. We will now suppose that the temperature slightly falls, and the thermostat completes the circuit to the right; the lower valve is then depressed upon its lower seat by the electro-magnet, preventing the exit and affording the free flow of water to the lower float F', which rises and elevates the beam B and thence turns on the draft. When the temperature again rises, the circuit is again broken by the thermostat and the valve again resumes its normal position, opening at the same time an exit for the water in the lower left float-casing and consequently lowering the float and beam and again turning off the draft. Should any accident occur to cause an excess of heat the opposite circuit is completed and the bell rings. It may be observed, however, that it is equally convenient to attach the thermostat in the opposite direction and have the bell ring when it becomes too cool. For this apparatus, two cells of the ordinary bluestone battery are used.

Another form of the same apparatus is shown in Fig. 2, the difference being that the supply to the tank is controlled by a float acting on a valve above it, the valve-lever, as in Fig. 1, being dispensed with. The magnets, of which there are two instead of one, act separately upon a single valve each, in place of a single magnet acting upon a double valve.

The magnet M and valve V to the right fill the float cases and raise the floats, as shown by the dotted lines, and the magnet M' and valve V', working through an overflow pipe, empty the cases and lower the floats.

The central one F of these floats, of which there are three, is used for operating the beam (not shown) connected with a damper, while the two side ones F' and F^2 are used for closing and breaking the circuits from the thermostat to the respective magnets. The current passes to them through the metal balls B' and B^2, until they are rolled by the floats to an insulated position I upon the divided metal gutter on which they rest.

In the drawing the thermostat bar is represented as having closed the cool circuit, and, by acting on the magnet M', having emptied the float cases and lowered the floats. But while the circuit remains closed at the thermostat it is broken at the ball and the valve, and is, therefore, shown in a normal position.

We will now suppose the heat to increase; the thermal bar T moves over and closes the right hand circuit, depresses that valve and flushes the float cases. The first effect of this is to close the broken circuit to the left, making ready for the next change; then to act on the middle damper float F, and, lastly, to break the circuit through the ball B^2 and so on to the end.

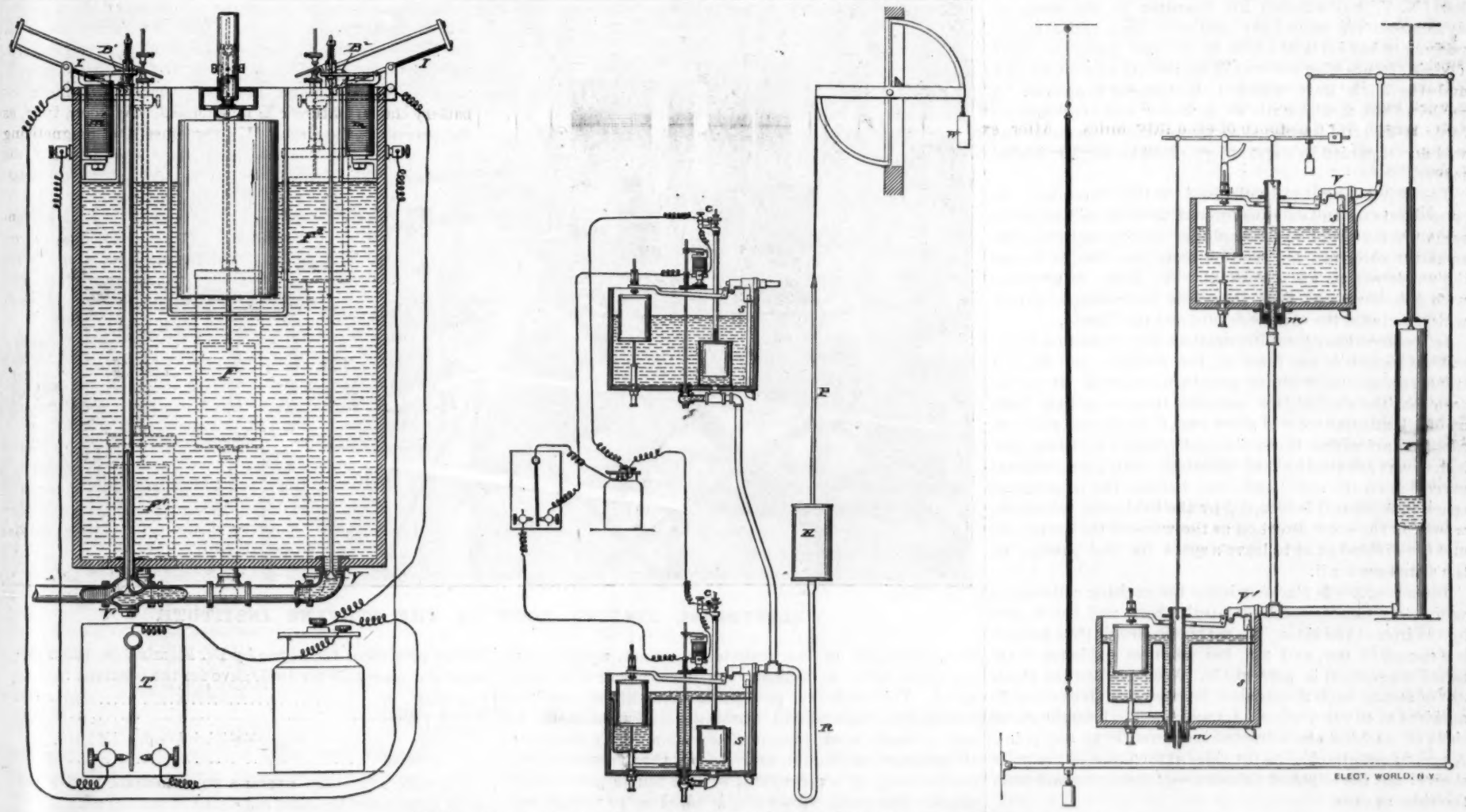
It will be seen that the circuits can be closed either way but for a very short time, thus permitting of the use of a Leclanché or other open circuit battery. The bell is disconnected, however, in this case, as both points of the thermostat are required to work the apparatus, but what is lost in the bell is gained in the battery and a separate thermostat can be used for alarm purposes.

A further modification of this apparatus is shown in Fig. 3. Here the magnets and valves are placed in separate tanks, one above the other, which permits of increased movement or pressure without increasing the work upon the magnets. In this case a circuit breaker with frictional contacts C is employed; and in place of a working float a hollow vessel H is connected to the machine by a rubber tube R and a stand-pipe P, the top of which is always above the water level in the upper box. This vessel, when filled with water, is heavier than the balance weight W on the opposite side of the window, which is shown open; but when emptied it is much lighter, permitting the weight to fall and close the same. The chains or ropes from the weight and vessel both work in grooved quarter-circles, always retaining their respective distances. The lower box is partitioned to prevent a useless waste of water, as it will be observed that it must empty completely with every other change, which is not the case with the upper box.

The necessity for this partitioning can be avoided, however, by placing the float-case, float and circuit-breaker upon the lower end of the pipe, connecting the two tanks and arranging the float of the same as a direct-acting valve on the opening through which passes the rod working the circuit-breaker. This will prevent the escape of water when the float is raised, and the circuit will be broken when the pipe is emptied, which will close the lower valve, retaining the box full of water.

Fig. 4 represents a purely mechanical contrivance wherein electro-magnets are dispensed with and in their place is used a vertical expansion bar of ebonite, connected by a series of levers to the valves in the tanks. In the place of valves there are used mercury cups M, having hollow stand tubes, into which are dropped extremely light glass tubes, open through from the top, but with a guide for the drop wires. These tubes being open through from the top prevent the siphoning of the mercury or the water through the mercury.

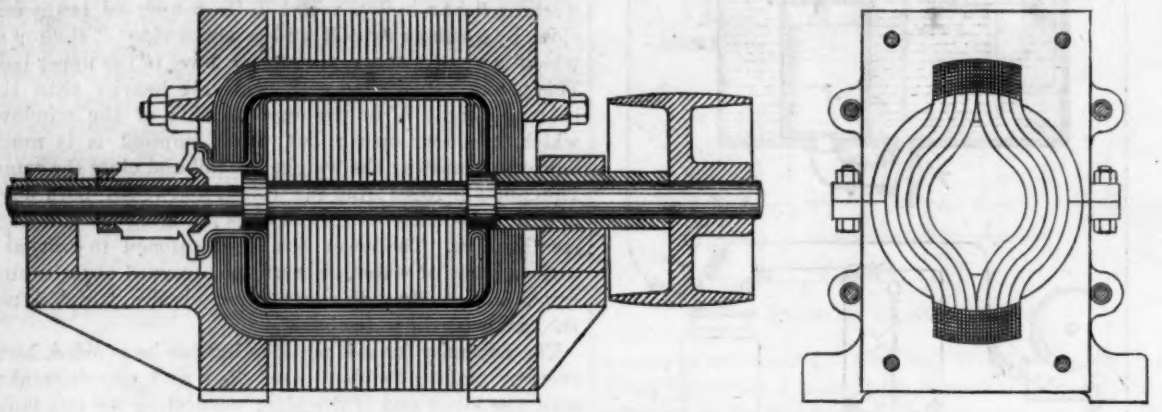
The maximum of water pressure upon the mercury cups in these machines is six inches, and, mercury being thirteen times heavier than water, it is only necessary for it to raise the mercury in the glass valve tube about half an inch to shut off the water escape. The wider the body of the mercury outside of the glass tube the less dip movement is required to obtain the desired half inch raise, one-sixteenth inch movement of the glass tubes being amply sufficient in many cases.



FIGS. 2, 3 AND 4.—REGULATION OF HEAT APPARATUS.

The method of operation of this machine is as follows: Upon the ebonite bar expanding, it acts upon the levers, which, as shown in the cut, have opened the upper valve and closed the lower one. The water then flows to the casing and raises the working float *F*; when the ebonite cools it will contract and close the upper valve *V* and open the lower one *V'*, thereby emptying the casing and lowering the working float. The stand-pipes *SS* terminating in the elbows in the tanks, Figs. 3 and 4, are for the purpose of preventing overflow.

There has thus far been no attempt to introduce these machines except among a few personal friends of the inventor and patentee, one of whom had a machine like that shown in Fig. 2 placed in his conservatory last October. It was attached to a Leclanché battery and the city water supply, and at this writing is in perfect working order and has never required even the slightest attention, with the exception of the addition of a glass of fresh water to the battery to replace that lost by evaporation. There is evidently a good market for such apparatus as the above described.



FIGS. 1 AND 2.—THE EICKEMEYER DYNAMO.

Eickemeyer's Dynamo Machine.

For several years past Mr. Rudolf Eickemeyer, of Yonkers, N. Y., has devoted his attention to the study of dynamo-electric machinery, and after long series of experiments has evolved a type of dynamo machine which claims attention on account of its novelty of construction and the high duty which it is claimed to possess. A model of the machine run as a motor was exhibited before the Electric Club of this city at its last meeting, and was accompanied by explanatory remarks by Mr. Eickemeyer.

The object sought to be obtained by this inventor is to concentrate the full exciting force of the field coils upon the armature core, and he accomplishes this by encircling the armature core with an exciting helix, and then inclosing the whole within an iron shell. The latter is provided with pole faces, and thus completes the magnetic circuit which includes the armature core and the cheeks.

In the accompanying illustrations Fig. 1 shows a longitudinal section of one form of the machine, and Fig. 2 a transverse section with the armature removed. It will be seen that the shell of iron inclosing the armature is built up of a laminated mass of sheet iron, to which end pieces of cast iron are added, the whole being bolted together. The iron sheets are stamped out circularly with a longitudinal extension on the upper and lower halves. The rectangular space thus formed is occupied by the field coils, which are wound in the same direction as the wires of the armature, and are divided so as to leave a space for the passage of the armature shaft.

The armature is placed within the exciting coils and is completely surrounded by the coils above and below, and by the iron at the sides. The magnetic circuit thus formed is a complete one, and not the slightest evidence of external magnetism is perceptible. We have had the pleasure of seeing such a machine in operation delivering 20 ampères at 40 volts, when a compass needle brought to the sides of machine was attracted indifferently at any point. A small tack attached to the sides at the point of the poles showed not the slightest adhesion—dropping instead from the sides at once.

As regards the output of this machine, it may be remarked that Mr. Eickemeyer has made the experiment of placing the armature of an old form of machine within the field such as he uses, and by employing the same amount of field wire as was used on the older form, he succeeded in increasing the output of the armature nearly twice.

Some Minute Figures.—Dr. Fleming says an incandescent lamp is not only a useful thing, but it has about it many points of great interest in physics. Many persons had the impression that the interior of a glow lamp was a place that was empty of all air particles, but this was not the case; it was as full as it well could be. Maxwell had shown that in a small cube of 1-100,000 of an inch there would be found 100,000,000 molecules of ordinary air, so that in a cubic inch of air there were a number of molecules represented by 100,000,000,000,000,000. In a Swan lamp when exhausted to one-millionth of an atmosphere, there remained some 400,000,000,000 molecules of air. As it took about ten days to count a million, a simple calculation would show that to count the number of molecules in such a vacuum would take 120,000 years of continual counting.

The Electrical Facilities of the Stevens Institute.

It was arranged during the exhibition of railway appliances in Chicago, in 1883, that the competitive tests of the dynamos there exhibited should be made at the Stevens Institute of Technology. The elaborate and thorough preparations for the tests which were accordingly made, says the *Stevens Indicator*, represented the combined abilities of some of the best electrical and mechanical experts in the country, and as no expense was spared in the matter, the facilities thus provided were complete, from both a scientific and practical point of view; and these the Institute retains, together with such improvements as have been suggested to Dr. Geyer by his experience in connection with some of the most important competitive tests and investigations since conducted.

A view of the contents of the gallery over the machine shop is given in the accompanying engraving, which exhibits some of the more important of these arrangements. In the foreground is a Weston shunt dynamo, mounted on a Brackett cradle. This balances the machine on knife edges in line with the axis of the spindle, so that only the difference of tension on the opposite sides of the belt affects the equilibrium of the scale beam; hence, weights upon the latter serve to indicate the horse-power at a given speed. This device for power measurement has now been accepted as the standard transmitting dynamometer for very accurate work, inasmuch as its simplicity eliminates all questions of friction and reduces the measurement to the certainty of a steel yard, with a single pair of knife edges. The cradle shown is graduated so as to read hundredths of a horse-power, and a variation of a single hundredth can be positively distinguished when twenty horse-power is being transmitted.

The apparatus is arranged to receive power directly from either below or above, from the 25 horse-power Buckeye engine in the shop, or by horizontal belt from countershafting on the gallery floor, driven by the auxiliary shop engines. Dynamo machines of all standard types, with capacities for 25 arc or 200 incandescent lights, can be mounted on this cradle.

The dynamo shown upon the cradle is the property of the Institute. It is provided with automatic and hand adjusting rheostats for the regulation or variation of its electrical generating power, and can thereby furnish electromotive forces of from 0 to 400 volts, and currents of from 0 to 40 ampères.

The two other dynamos shown in the engraving are series-wound machines, the smaller of which is available as an independent field exciter to the larger, thereby enabling the latter to supply incandescent or arc currents, as may be desired, the range available being 130 volts and 20 ampères.

In addition to these generators there is available a set of storage batteries running up to 120 volts. With this combination of generators, it is quite feasible to maintain, in continuous action day and night, a number of incandescent lamps of any of the standard types and sizes.

Of equal importance is a means of standardizing, on a practical scale, all instruments for accurate measurement. Such can be found in a large German silver rheostat, composed of about 2,400 feet of wire (No. 12 B. W. G.) stretched in thirty rows upon the roof trusses over the gallery, which the engraving exhibits. By the use of this rheostat, resistances, in series of 30 ohms or .033 ohms in parallel, may be secured, and currents as great as 200 ampères may be handled without danger of overheating the wires. A resistance practically perfect, because of its uniformity, is therefore available for calibration work, and highly satisfactory results are obtained by the combined use of this rheostat and the silver voltameter used upon currents as high as five ampères.

The following table shows the results of a recent calibration of a voltmeter and ammeter for an investigation of the durability of certain incandescent lamps at present being carried on by Dr. Geyer. Two silver voltameters were used, being connected in multiple arc. The instruments which were calibrated were plain tangent galvanometers, with needles ten inches in length, graduated to ten minutes, readable to single minutes, and easily sensitive to even this degree of minuteness.

The results obtained were as follows:

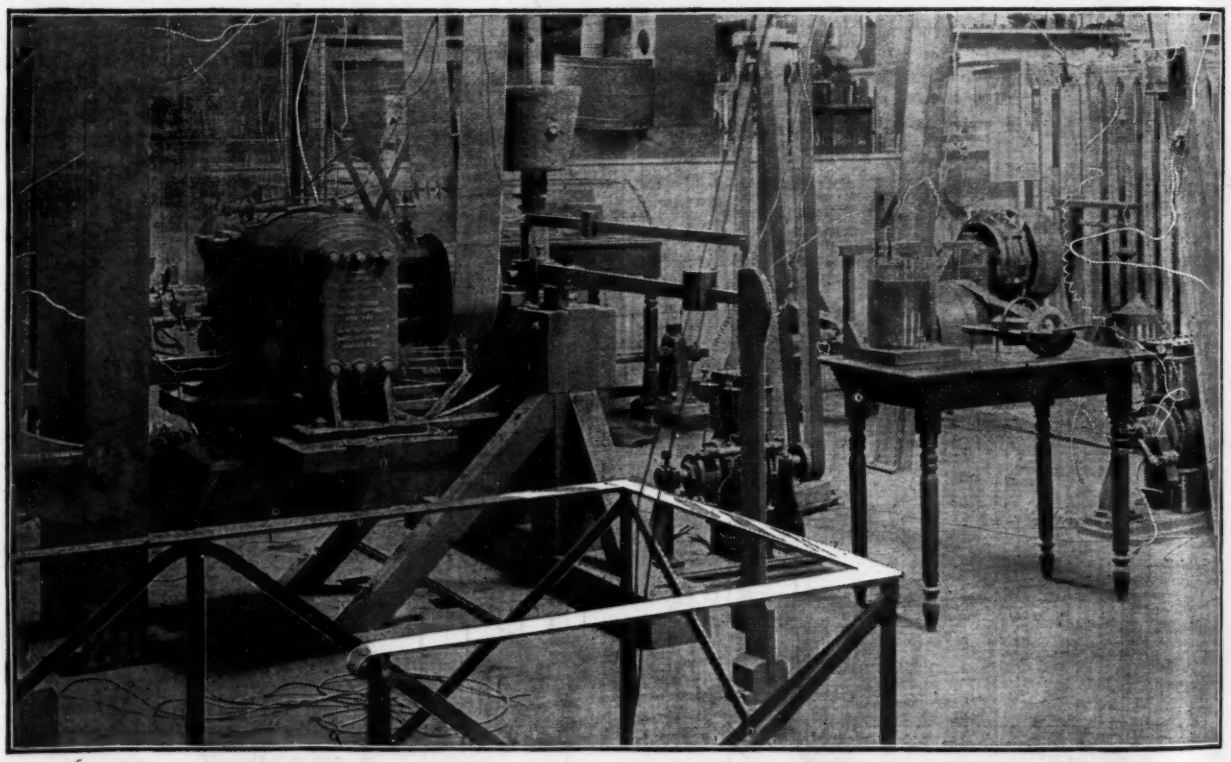
Date of experiment.	Constant for Ammeter.	Constant for Voltmeter.
August 2d	4.844	49.23
August 2d	4.842	49.01
August 4th	4.846	49.20
August 4th	4.861	49.29
Average	4.848	49.18

The variation of maximum or minimum values from average value was about one-fourth of one per cent.

An independent calibration of the voltmeter by the use of the standard form of Daniell cell, recommended by Sir William Thomson, and prepared and used under the conditions prescribed for its use by Dr. Fleming in the *Philosophical Magazine* for 1885, gave for the constant:

First trial	49.09
Second trial	49.20
Third trial	49.10
Average	49.13

This differs from the average value obtained with the silver voltameter by about one-tenth of one per cent.



ELECTRICAL TESTING ROOM OF THE STEVENS INSTITUTE.

A Big Number.—The last number of THE ELECTRICAL WORLD achieved the distinction of being the biggest number of an electrical journal ever published, and it must also have come near being the biggest regular number of any trade journal whatever, for it had forty-eight pages, and those pages are by no means little. Publisher Johnston is to be congratulated on the fact that two-thirds of the issue was taken up with first-class advertising, signifying that THE ELECTRICAL WORLD specifically and the electrical world generally are in a flourishing financial condition. It is noteworthy that of the advertisements a dozen pertained to the use of electricity for power purposes, and that six companies present themselves as ready to equip and maintain electric railways. The suggestiveness of these facts is heightened by reading the stenographic report of the proceedings at the recent meeting of the National Electric Light Association in Philadelphia. This report occupies more than thirteen of the sixteen pages of reading matter in the number, containing papers and discussions of great interest to electricians. For the general public its striking feature is the portion of it devoted to the power business, showing that the electric light people are realizing what an important part of their work will be the sale of power.—*Boston Globe.*

Intermittent Current Telephone Transmitters.

BY JOHN E. DANN AND J. LAPP.

In nearly every experiment made to test the value of the Bourseul and Reis method, the cubical box transmitter, or some invention of recent date, was used, and because of the failure of these instruments to transmit perfectly the public generally have come to the conclusion that the intermittent current cannot transmit speech. It would appear that Reis' object was not to give the public a speaking telephone, but to publish to the scientific world the fact that sounds could be transmitted electrically, he supposing the telegraph to be ample for the needs of modern life; and although he had good articulating telephones, so delicate was their adjustment and so unreliable, that in placing his telephone in the hands of scientific people he preferred to give them an instrument that could not get out of adjustment. Therefore, he gave them his cubical box transmitter.

It is absurd to say, in the face of statements made by his contemporaries, that he could not, or did not, transmit articulate speech. We have tried many experiments with the cubical box transmitter, with the instrument described by Legat—a Reis—and the instrument described by Charles Bourseul. We find that when the cubical box is used exactly as described by Reis, viz., as a make and break, and spoken to loudly, so that the vibrations of the electrodes can be plainly heard, and an amount of battery used that will not arc across the gap, then it transmits so that nearly all can be understood. With the lever instrument, adjusted so as to make and break when the vibrations strike the diaphragm, no trouble is experienced in carrying on long conversations. With the Bourseul instrument, the transmission is very good. We have experienced the same difficulty that no doubt they had in keeping the instruments in the proper adjustment, that they would make and break the circuit by the vibrations of the diaphragm, and this trouble is unquestionably the reason why Reis did not put his lever telephone in the hands of inexperienced persons, although it was a *speaking* telephone.

We were led to these experiments by having constructed an intermittent current transmitter. There is some difference of opinion as to what an intermittent current transmitter is. Some have tried to establish that a certain transmitter was such, where the only evidence they could bring was an extremely fine-drawn theory, and the instrument in question did not differ from what are acknowledged to be undulatory current instruments. All fair-minded men acknowledge that a make and break should be loud, and have the same evidence of its make and break character that the Reis has, viz., a buzzing sound made by the electrodes. The chief counsel of the American Bell Telephone Company, Mr. Storrow, said in a brief submitted to Mr. Lamar last winter that, "if a make and break could be made it should be heard at least two feet from the receiver, whereas the best undulatory cannot be heard six inches from the receiver." Our instruments corroborate the statement of this gentleman, for when using one cell of Leclanché battery over an ordinary No. 12 iron wire, grounded and one-quarter of a mile in length, speech can be heard eight or twelve feet away, and understood perfectly. There are no foreign sounds whatever, and many of the words were understood twenty feet from the receiver in a quiet room. In our transmitter there exists the same evidence of its make and break character that exists in the Reis, viz., the buzzing sound heard by a person standing near the transmitter, caused by the motion of the electrodes.

The faults of the Bourseul and Reis instruments are the difficulty of maintaining adjustment; and the fact that the parts of the instrument themselves after a short time acquire motion, and thus open and close the circuit and send to line currents where there is no corresponding air vibration. Many of the foreign sounds heard in the receiving instrument arise from this cause. But the chief trouble in the use of these instruments now arises from the desire of the parties using them to use the Bell method. Having no faith in the Reis intermittent current, they assert that Reis never intended to use it; they speak gently, so as not to break the current, or, if compelled to speak louder, they again avoid the issue by using battery, so that the current will arc across the gap made by the parting. They hope to get the Bell undulatory current, forgetting that the current crosses the gap as a series of throbs or sparks. Each of these being heard in the receiving instrument, drowns out all articulation and gives it the toy trumpet tone complained of.

ELECTRIC GOVERNOR FOR WATER-WHEELS.

All that is required to transmit sound electrically is to send to line currents of electricity that correspond in number and intensity to the air vibrations of the sound, and it is quite immaterial whether the current is undulatory or intermittent; though any electrican will understand that, if the current is intermittent it is a long-distance and loud-speaking telephone. To accomplish what some are pleased to term an impossible feat, all that is necessary is to so construct the apparatus that the air vibrations striking the diaphragm can cause a separation of the electrodes; and to so arrange the apparatus that whether the extent of the air vibration be great or small, the blow struck by the diaphragm electrode on the second electrode shall be in proportion to the air vibration; and that the blow be received in such a manner that the second electrode will not be set in vibration, as every blow not represented by an air vibration causes a foreign sound to be heard in the receiver.

When we consider the force of the air vibrations, and the conditions necessary for a practical make and break transmitter, it is not strange that inventors prefer to make varying contact transmitters, or that the world has long thought a make and break an impossibility.

The separation of electrodes has been established in many ways; one of these was auricular. A test was made, however, that was mathematical in its certainty and fully showed that the separation broke the current. Electricians and others who have examined this instrument testify that so far from the method of Reis and Bourseul being worthless, it is the correct method, giving better articulation, and the method producing a long-distance telephone. As regards articulation, fractions and unusual names are readily understood by persons unaccustomed to the use of telephones.

An Electric Water-Wheel Governor.

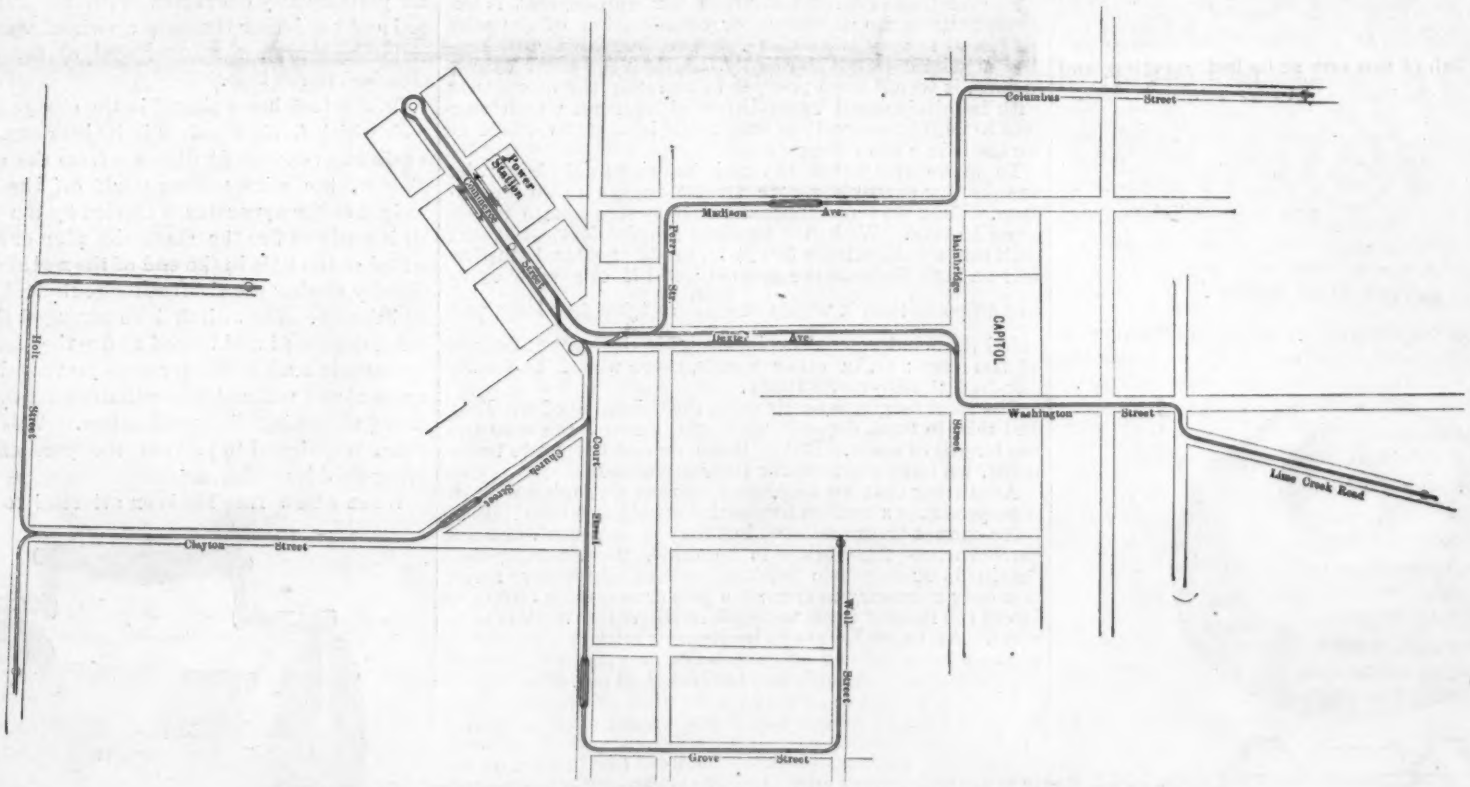
The regulation of dynamos can be effected in various ways, one of the most simple of which is the varying of the speed of the armature to correspond with the electrical load. A governor designed for this purpose and adapted to be attached to water-wheels, has been constructed by the Globe Iron and Electric Engineering Works of Chicago, and is shown in the accompanying illustration. The current from the machine passes into two large coils, to one of which is attached an armature, which works two small friction wheels that run in opposite directions, power being obtained by a belt from the countershaft, which runs on a pulley, with another pulley on either side. When, by the turning out of a light, the current becomes too strong, the armature is drawn down, pressing one of the friction wheels against a larger wheel. The latter then operates a cog wheel, which moves a bar that slides the belt on to one of the side pulleys. This is connected with a gearing and partially closes the gates on the wheel.

As the power diminishes, the current grows weaker, until it again attains its normal strength. The armature is then no longer attracted, and the friction wheels, being no longer attracted, the motion of the shifting belt ceases after reducing the speed to the proper point. When a light is switched into the circuit, the armature is drawn in the opposite direction, which brings the other friction wheel into action and increases the speed of the dynamo correspondingly. An attachment to the governor consists of a coil which is so arranged that if the circuit is broken a lever is released, which, working on a fulcrum, holds the armature down and the water is entirely shut off the wheel, thus stopping the machine.

The Montgomery, Ala., Electric Railway.

The Capital City Electric Railway of Montgomery, Ala., which commenced running its street cars by the Van Depoele electric railway system one year ago, is now equipping its road with the most complete and extensive electric railway outfit in the world. The total length of track being equipped is over eleven miles. The accompanying diagram shows the lines of the road. It will be easily understood by any one familiar with the city.

There are four lines of road, the cars all starting from the same point, which is at the end of the double track on Commerce street near the railroad depot.



PLAN OF THE MONTGOMERY, ALA., ELECTRIC RAILWAY ROUTES.

The Court street line runs up Commerce street, turning at Fountain square, up Court street to Grove, up Grove to Hill, up Hill street as far as Scott street. This is the line which has been run by electricity for the past year. The length of track is 2½ miles. Four cars are used. The grades run up to 7 per cent.

The Dexter avenue cars run up Commerce to Fountain square, then up Dexter avenue to the State Capitol, then on Brainbridge, Washington and Union to the Park, 3½ miles; 8 cars.

The Madison street line runs up Commerce to Fountain Square, up Dexter avenue and Perry street to Madison; on Madison, Bainbridge and Columbus to the Cemetery, 1¼ miles, and has 3 cars.

The Clayton street line runs on Commerce, Court, Church and Clayton to Holt, one branch turning up Aaron street and ending at the Mobilo; 2½ miles and 4 cars.

At Fountain square all the cars diverge in three different directions from the main track, thus making Commerce street the main trunk, with four branches.

Any practical street railway man can see the difficulty of

making these switches in track and electrical conductors, all the cars having to cross other tracks before they go back to the starting point or power station.

The power station is situated near the end of the track on Commerce street, where on a valuable piece of real estate in the heart of the city has been erected for this especial purpose a handsome and permanent brick building three stories high and 70 by 100 feet. The lower floor is occupied by offices, engine and dynamo room, boiler room and car room; the second floor will be used for offices and repair room, and the third as occasion requires.

The steam power consists of two batteries of steel boilers of 240 horse-power each capacity; two Porter-Allen engines of 120 horse-power each, with all modern improvements, as to heaters, pumps, steam gauges, etc. The engines are connected to a main shaft, and friction-clutch pulleys are used throughout wherever they may be needed.

The electrical outfit consists of a 240 h. p. dynamo, with many new appliances. This dynamo is of an entirely new construction, made especially for railway work. Mr. Van Depoele, of the Van Depoele Company, has been working some five years upon this invention. The dynamo weighs about fourteen tons, and is made to run at slow speed. The motors are of the new Van Depoele pattern, and are placed upon the front platform of the cars. They are easily managed. Some are placed on the old cars, and some will be attached to the new cars being made by Brill & Co., of Philadelphia. The conductors are overhead wires, the same as are used at Appleton, Detroit, Port Huron and Scranton. The electrical outfit to complete this plant was ordered after almost one year's experience with the Van Depoele system. Every objection to the electric railway system has been thoroughly canvassed and carefully considered. The whole equipment will be completed in April.

The officers of the company are: E. B. Joseph, president; Taylor Roberts, secretary; J. A. Gaboury, manager; F. E. Gaboury, superintendent, and Thos. E. Hannon, treasurer.

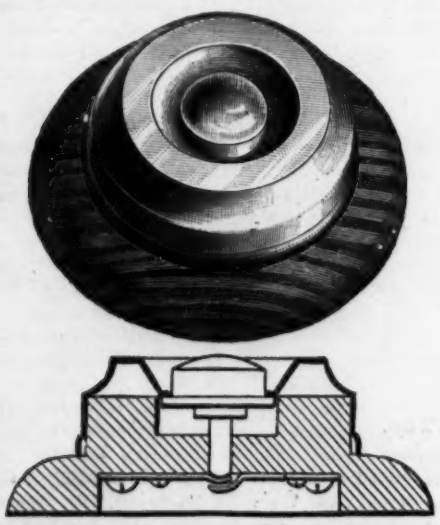
Mr. J. A. Gaboury, the manager, is a large stockholder, and although busy in perfecting and introducing his new cotton compress, has taken time to thoroughly investigate this subject. To his enterprise is largely due the carrying out of this great work, which will be a credit to the growing city of Montgomery.

Like all cities in which electric railroads have been adopted, Montgomery is experiencing a boom in business, and real estate is so rapidly advancing in value as to astonish the old natives who predicted the failure of the attempt to "run the mule cars by lightning."

The spirit of progress is abroad in the Southland; its handmaid is electricity, and the "old fogies" must wake up or sleep on forever. Montgomery leads the van, and other Southern cities are soon to follow. It is, in fact, a most striking evidence of the new spirit of enterprise in the South that so much of the new electric lighting and new electric street railway business is being done there.

An Improved Push Button.

In damp and dusty situations, much inconvenience is experienced from the contacts of push buttons becoming



FIGS. 1 AND 2.—NOVEL PUSH BUTTON.

corroded, where contact is obtained by pressure alone. To avoid this difficulty, the Electric Gas Lighting Company, of Boston, have recently designed the push button shown in the accompanying illustration, Fig 1. The push shown in section in Fig. 2 consists of two spring strips which overlap each other, and, when pressed by the button, are deflected and rub against each other. In this way the contact is always kept bright and clean. The button, made in imitation of amber, is held in position by a nickeled cap and the whole presents a very neat appearance.

Disintegration of Converters.—A correspondent, "F.," writes as follows: "In your issue of Feb. 26, Mr. Carl Hering states that the coil of the Zipernowsky-Deri converters will 'disintegrate quickly.' Why will it disintegrate? Is it the copper wire, the iron, the insulation, or what is it that will disintegrate? Why will it disintegrate more rapidly than the Gaulard & Gibbs converter?"

Some Practical Questions in Magnetism.

The following remarks were made in the discussion of the paper read by Mr. T. Wolcott on the above subject, at the last meeting of the Electrical Section of the American Institute, and printed in our issue of March 5:

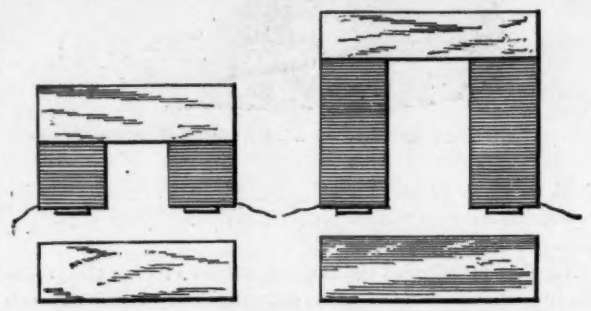
Mr. C. S. BRADLEY: I wish to present what seems to me a new view of the action in electro-magnets which, with Mr. F. B. Crocker's assistance, I have arrived at.

My first proposition is, that a certain magnetic potential is set up by every ampère-foot of wire, whether adjacent to iron or not.

We are all well aware of the production of currents in adjacent parallel wires when a current is started or stopped in any given conductor, and I attribute this to magnetization, so that an experiment is unnecessary to illustrate it. We often hear that the magnetic effect is due to the number of ampère turns, and this is right within certain limits when the diameter of core remains the same, but when the area of cross-section in the core is changed, the magnetism is no longer proportional to the ampère turns but proportional to the ampère-feet. It appears absurd that one turn of wire, carrying one ampère, around a core ten inches in diameter, should have the same magnetic effect as a turn of wire carrying one ampère around a core one inch in diameter.

By ampère-foot I mean a foot of wire carrying one ampère of current, and on electro-magnets the length calculated as if the wire was all wound close to the core; that is, the difference in length between the outer layers and the ones nearest the core must be deducted from the total.

To produce a good result not quite up to saturation in very good wrought iron, it is necessary to have about 500 ampère-feet to every square inch of core area. This



FIGS. 1 AND 2.—SOME QUESTIONS IN MAGNETISM.

includes both limbs of the magnet, and from a number of examples, one of which is the little ½ h. p. motor of the C. & C. Company, another, the fifty h. p. dynamo of Hopkinson and several other makes, we find this to hold true.

The electrical energy consumed per ampère-foot is dependent upon the resistance or cross-section of the wire used, and in very large cores, where increased cross-section of wire does not so rapidly lengthen the outer convolutions, it would seem possible to maintain the magnetism with infinitely small expenditure of current, which suggets to us that magnetism once made is a static effect as we see it in a steel magnet.

To make the use of the unit (ampère-foot) plainer, let us take, for example, a core twelve inches in circumference. Then we have approximately twelve square inches cross section. With five hundred ampère-feet per square inch this would call for 500 × 12, or six thousand ampère-feet on both limbs of the magnet; and if our wire carry five ampères then it would be $\frac{6000}{5} = 1{,}200$ feet long, provided the winding could coincide with the circumference of the core; or, in other words, there would be twelve hundred (1,200) convolutions.

The total length depends upon the thickness of winding, and this, in turn, depends upon the size of the wire and the length of cores. But as these demand separate treatment, we have not time for their discussion.

Admitting that an ampère of current through a foot of wire produces a certain magnetic potential, whose lines of force cannot be annihilated but may be scattered, and not carried where the work is to be done, then, having once obtained our magnetic potential or magneto-motive force, it is only necessary to furnish a proper magnetic circuit to direct the lines of force to the place where the work is to be done. And now I want to invite your criticism to a seeming exception to the proposed law of magnetic circuits corresponding to Ohm's law for electrical circuits.

In the illustrations, Fig. 1 represents a short, thick magnet, and Fig. 2 a longer magnet of similar cross section.

In Fig. 1 the lines of force would not be perceptibly scattered. In Fig. 2 the magneto-motive force would be higher, owing to there being more wire upon the cores, and consequently more scattering of the lines of force, and especially more lost between the limbs of the magnet. Therefore, in order to utilize the lines of force to the best advantage it would be necessary to make the air space less than in Fig. 1, or, in other words, place the armature closer. But in electrical circuits we make the internal resistance bear a certain relation to the external, and in order to compare the magnetic circuit let us call the iron portion the internal and the air space the external resistance. Then we have a greater internal resistance in Fig. 2 than in Fig. 1; consequently we should have a greater external resistance, which means that the armature should be moved farther away, making the air space more instead of less, as is the case when we wish to reduce the scattering lines of force

The Effects of a Blizzard.—The following is said to have been noticed during a blizzard at Cando, Dak., last month: "The wind coming from the west, impinged with great force upon the west front of the county building, passed along the north and south sides, and formed an eddy at the east side. The friction, in passing the northeast and southeast corners was so great as to generate electricity in the apartments in the east end of the second story of the building, highly charging every object in the rooms. The electricity was so strong that personal contact between the occupants produced a perceptible shock. When a Dakota blizzard develops lightning in mid-winter with the mercury below zero, some idea may be formed of its tremendous power."

Portable Electric Shot Firing Apparatus.

BY W. E. IRISH.

The application of electricity by civil and military engineers to the firing of mines and to blasting purposes generally in the quarry, mine and for the removal of obstructions has been found of such great value that few such men, knowing their profession and working in earnest at it, can afford to be without an electric-firing outfit. Some objections against its more general use have, however, been raised by one or two of the old-fashioned time-fuse men who have unsuccessfully tried to show that the firing of shots by electricity is more costly than by the unreliable and very dangerous time or slow-match fuse; and that the parts and connecting wires are so complicated and confusing that no person can handle or operate the apparatus with safety, unless he has a thorough electrical knowledge.

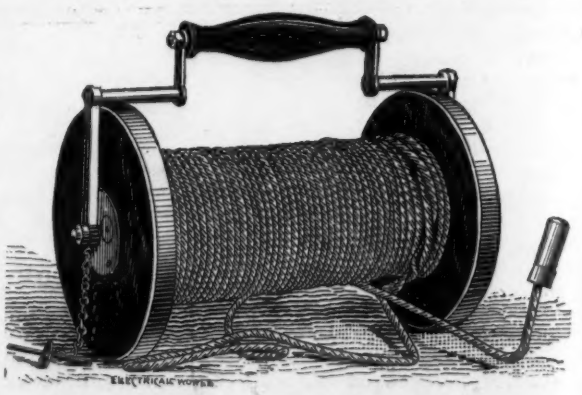
These assertions about the electrical apparatus are simply due to a want of knowledge on the part of its adversaries, as all engineers having practical experience with the two methods know full well that the electric, whether employing the dynamic exploder, the frictional machine, or the portable electric shot-firing apparatus, is much less costly, more handy, safe, and reliable than the other, and that a shot can be prepared and fired by means of electricity in a fractional part of the time occupied in preparing and firing the same by a time fuse. The gain by the saving of time in one operation alone, where many men are engaged, will more than defray the entire cost of a complete outfit which would fire without additional outlay hundreds of other shots. Where blasting operations are frequent, the saving is very considerable, and the risks incidental thereto are reduced to a minimum.

The second objection is, as the first, quite imaginary; but to meet the objections according to their weight, the little apparatus here illustrated and described, was specially designed by the writer. It consists of a wooden reel containing on the inside of the core a small cylindrical dry battery, an induction coil, and a condenser.

The battery will last twelve months, working daily, and when exhausted is withdrawn and another inserted in its place, as a cartridge would be in a breech-loading fire-arm, the operation taking no longer to perform in one than in the other. On the outside of the core and between the cheeks of the reel is wound an insulated double flexible conductor of any desired length; one end of this is connected semi-permanently to two insulated terminals which are permanently connected with the battery, induction coil and condenser through a switch arrangement at one end of the reel, the other end of the conductor being attached to the fuse.

On the fuse being placed in the charge ready to fire, the reel, which freely revolves in its bearings, is conveyed to a safe and convenient distance from the scene of the explosion, the wire paying itself off the reel by its own weight as the apparatus is carried by the handle. When all is ready to fire the shot, the plug or switch-key is inserted in the hole in the end of the reel and given one turn, thereby closing the electrical circuit and firing the fuse and charge. The switch is so arranged that on the key being depressed and turned to fire the charge, it locks the contacts in such a manner as to prevent the circuit being again closed without first withdrawing the key, inverting it and unlocking the mechanism. This locking contrivance is designed to prevent the possibility of a charge being fired by accident.

When a new fuse has been attached to the conductors,



IRISH'S SAFETY EXPLODER.

and the necessary unlocking operation performed, the apparatus is again ready to effect another explosion. The conductor is rewound by causing the reel to revolve by friction of the hand against one of its ends, or by means of a crank-handle not shown in the illustration. This apparatus has the advantage of being self-contained, always ready in all weathers, subject to no hanging or missfiring, and well able to withstand rough usage. From one to four shots in continuous circuit can be fired simultaneously, and a greater number of charges can be exploded in such rapid succession as to be practically simultaneous.

Fire in East Boston.—A fire occurred last week in the old wooden building in East Boston occupied by the Citizens' Electric Light Company. The loss on the building will amount to about $1,200, and several of the dynamos were injured. The cause of the fire is unknown. The fire did not interfere with the lighting of the streets, which went on as usual.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, March 7, 1887.

The investigation into municipal expenditures is now going on over in Brooklyn, but so far it has not made much difference in electric light contracts. At the last meeting of the Aldermen, the regular contracts for gas and electricity, amounting to $410,000, were made, and a resolution to cut off 250 arcs was snowed under by 14 to 4. In fact, the number ought to be increased rather than diminished, for the lights do much to render the streets of Brooklyn cheerful and safe by night, and that is far more than could ever be said of the dim gas lamps.

The first of March has come and gone, but all the subway work that should now be going on is suspended awaiting the action of the Legislature. I understand that the direct testimony in the suit of the North American Underground Telegraph and Electric Company against Hess, or the Subway Commission, was closed last week on behalf of the complainants.

Mr. C. O. Mailloux, the well-known electrical expert of this city, gave a highly interesting lecture before the Franklin Institute, Philadelphia, last week, on the secondary battery. It will be remembered that some of the Julien cells were used at the Institute at the time of the visit of the National Electric Light Association, and Mr. Mailloux, who paid these batteries a high compliment as being a great advance and well adapted for various work, took the opportunity to use them in illustrating his lecture. There is the liveliest interest in this storage battery subject in New York to-day, and I have heard several gentlemen say that they would like Mr. Mailloux to give a talk on this subject before one of the societies here.

I note in the papers some talk about a desire or effort on the part of the Standard Oil Company to control the manufacture of sulphuric acid, and then to raise the price on the unfortunate consumer.

In the three actions of the Edison Electric Light Company against the First National Bank, and a like number against William H. Jackson, and the same against the Consolidated Electric Light Company, Judge Wallace, of the United States Circuit Court, denied, last week, the motion of the defendants to compel the complainant to file with the clerk of the court the original letters patent granted to Thomas A. Edison, in the Dominion of Canada, kingdom of Italy and by the Austro-Hungarian empire.

The Daft Electric Light Company have just shipped ten electric machines to the Worcester, Mass., Exhibition, which opens on the 14th inst. All of the machinery at the exhibition will be operated from the central station of the Worcester Electric Power Company, who employ Daft machines entirely. It is designed to make this the most interesting mechanical and scientific exhibition yet held in Massachusetts, and much interest is manifested by capitalists and mill men generally, especially in the performance of the Daft motors. By request of the managers the exhibition will be opened by Mr. Leo Daft, of the Daft Company.

The Worcester Electric Power Company now have a large number of Daft machines on their circuit, and expect in a short time to supply all the mills and factories for miles around. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, March 7, 1887.

At a recent meeting of the stockholders of the New Bedford (Mass.) Edison Electric Illuminating Company it was voted to increase the capital stock to $100,000.

The Malden (Mass.) Gas-Light Company, doing business in the towns of Malden and Melrose, has taken steps toward obtaining authority from the legislature to furnish electric lights also.

The Sawyer-Man Electric Company has just sold a 500-light incandescent plant to the Greenfield, Mass., Electric Light Company. The former company is also wiring the Mansion House at Greenfield for incandescent lights; all other illuminants are to be discarded throughout that hotel. It is reported that the Kearsarge House, North Conway, N. H., also owned by the Mansion House proprietors, is to be equipped from cellar to dome with incandescent lights of the Sawyer-Man system.

Messrs. Paine & Francis, of Boston, the New England agents of the Edison United Manufacturing Company, have achieved creditable success since the summer of 1886, in having averaged a plant a week up to the present date—in the installation of isolated incandescent electric lights. Among the plants recently installed by the gentlemen named are the following: A 300-light plant at Blackington Woolen Mills, Blackington, Mass; a 100-light plant at the mills of the Massasoit Paper Company, Holyoke, Mass.; a 150-light plant at the mills of the Hollingsworth & Whitney Paper Company, Watertown, Mass.; and an increase of 400 lights to the plant of the Arnold Print Works, North Adams, Mass.

Bell Telephone stock showed more activity during the past week than it has for some time past, and on transactions of from five to fifty share lots on March 5 it gained from 218 to 224.

A dispatch dated March 3 from Harwich, Mass., reports the French Cable Company and the Western Union Telegraph Company as still being at loggerheads there. The combined lines which heretofore were operated by the latter named company have been separated, and the former company has established an office at some distance from the latter.

Mr. W. Irwin Wark is the manager of the New England Electrical Supply Company recently established at 27 Bromfield street. It carries a full line of electric light supplies, does wiring and makes a specialty of small installations of incandescent light. Mr. Wark, who was formerly with Frenyear & Razee, is well known, and is likely to secure a good run of business.

The City Committee on Electric Wires held a meeting Thursday afternoon to consider an order offered and adopted in the Board of Aldermen by Alderman Carroll, Feb. 21. The order provided "that the Committee on Electric Wires be requested to investigate and report whether the Municipal Signal Company has attached any of its wires to telegraph, telephone or electric wire poles in this city without permission of this board." Representatives of the Western Union Telegraph Company, the fire-alarm telegraph, the telephone companies and the Brush Electric Light Company were summoned, and it was shown that no permission had ever been given to the inventor of the police signal system to attach wires to poles of any of those companies, which have had rights granted them to maintain poles in the district in question.

A trial of the Bickford electric railroad train signal, which you illustrated and described last week, has been made on the Old Colony road. Several prominent railroad officials took a trip on the train leaving Boston for Newport, R. I., at 9:30 A. M. A thorough trial of the system was made—the signal being "rung in" to the engineer with the train running at full speed, and a prompt stop made. Again a test was made by "cutting off" a car, when the electric gong in the engine cab immediately rung, notifying the engineer of the fact. The signal is intended to displace the bell cord, which has been found to be impracticable on long trains, the engineer failing to receive any signal when it is pulled.

Mr. J. Z. Rogers, 70 Devonshire street, is busy pushing the interests of his company's mail box indicator, by means of which the fact that mail matter has been put in a letter box is immediately announced to the addressee in his office or room. This neat little invention is heartily indorsed by the post-office people, as it will tend greatly to save the postman's time.

Apropos of the storm, a young man named William Chapman, of New London, informed the Providence *Journal* man at 4 o'clock Friday afternoon that he expected a thunderstorm before morning. At that time there was no indication of it shown by the appearance of the clouds, the height of the barometer, or the register of the electrometer, but the boy proved a true prophet, nevertheless. When Chapman was asked how he was able to foretell the storm he said that a year and a half ago his father's house was struck by lightning, and he was stunned by the shock. The current passed through his body and went out at his right heel, which was painful for some time afterward. On every occasion of a thunderstorm since then he feels, hours before the time, a tingling pain in the heel, and thus his prediction.

Representatives of several telephone, telegraph and electric light companies went out to Brighton on a recent afternoon to inspect a new arrangement for carrying underground wires—a conduit recently patented by the American Conduit Company. These gentlemen, believing that eventually all wires must go underground, have, after three months of experimenting, succeeded in perfecting a machine for the manufacture of what they consider an imperishable conduit. They claim that it is practically indestructible, and that it can be manufactured and put under ground at a cost less than is required to keep wires and poles above ground in repair for a year. The conduits are manufactured from cement and sand, and after being shaped are treated to a bath of hot asphaltum, which makes them impervious to water and perfect insulators as well. If the system of heating business establishments and houses by steam from a central station through underground tunnels should ever be adopted, these conduits could be used for running the pipes. W. I. B.

PHILADELPHIA NOTES.

PHILADELPHIA, Pa., March 5, 1887.

When cities let their light shine, country towns are sure to get the reflection, if not the direct rays. The present boom in electric lighting spreads like a contagion into all the live smaller cities and towns, realizing Bob Ingersoll's wish that "*health could be catching!*" Downingtown is heard from in this connection, several citizens of means being engaged in organizing a company for introducing this improvement into houses, places of business and for street illumination. The Edison Electric Light Company, of West Chester, besides supplying the town, furnishes light to the county prison, each cell being supplied with a six candle-power lamp, on the reasoning that our criminals need enlightenment. The Wayne Electric Light Works (Edison system) are a decided success. Some of the solid men of Doylestown are examining some of the best plants of her sister corporations with the view of introducing this modern illumination into the capital of Bucks County at some time in the near future.

Information from headquarters of the Westinghouse Electric Company says that they have closed orders within the last two weeks for central stations on their new "secondary generator" system to the number of over 12,000 16 candle-power lamps. Since their first plant of 500 lights on this system was started, in December last, they have closed for 22,100 16 candle-power lamps in central stations alone.

An idea seems to obtain that this is only the much maligned "Gaulard-Gibbs" system, but, except in principle, the apparatus is entirely new, and the results attained will make some of our theoretic scientists open their eyes.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, March 5, 1887.

I give below some interesting chat taken from the "Club Man's Gossip" column of the local *Mail*, one of Chicago's brightest newspapers. What he says about Chicago being headquarters for most of the opposition, or, as the Bell people prefer to call them, "wild cat" telephone companies, is strictly true: As the time for a decision in the telephone cases approaches, the many holders of the high-priced telephone stocks are getting anxious, and the many persons who have put up their money for a desperate chance in the new companies are getting excited. The anxious people for the most part live in Boston; the money which is backing the new companies was almost altogether subscribed at Chicago. There are, of course, the owners of stock in the local Bell companies all over the country; but even the stock in these local companies, where it has proved especially valuable, has gradually worked its way toward the Hub and is in the hands of the millionaires who are directly interested in the patents. But without regard to the holding of stock it is a fact that the *secrets* of the telephone business are held here in Chicago. All the fighting companies were organized here—nearly a half dozen of them, including the Gray, the Overland-Baxter, the Drawbaugh, the Pratt & Plumb and the Dolbear. There are a half dozen men who used to be in the employ of, or associated with, the original Bell and Edison companies, and contributed in ways small and great to the telephone patents, who are now here and working tooth and nail to upset their old employers or partners. The money to carry on the great fight at Washington, so far as that was a private one, was contributed here. The whole telephone history, inside and outside, before the patents were issued and afterward, could all be written from here.

The fight made against the Bell company by Prof. Gray has attracted the most attention for a variety of reasons. Gray is a famous electrician whose claims are admitted by the Bell people to a certain extent, but they simply assert that he sold out his rights. Gray has led the fight, and his sensational assertion that his caveat was stolen by the Bell people is the sensational charge upon which the government was prevailed upon to assume the prosecution and bear the load of the expenses. The money for Gray's fight is furnished by Hale, the elevator man, the Peck brothers, N. B. Ream, John B. Alley, of Boston; E. S. Pike, the real estate man, and F. D. Gray, of the First National bank. This latter is supposed to represent the interest of what is known as the First National bank crowd, including S. M. Nickerson and Lyman J. Gage. Next in importance comes the Overland company, which was organized under the Baxter patents. This patent does not rank as high as the Gray; but the company has this great advantage; it has canvassed a half-dozen cities, including Chicago, and if the Bell patents are broken it will be in the field the next day, stringing its wires and putting in its instruments to customers who are already secured. Senator Edmunds is a large stockholder in the Overland, a fact that apparently has escaped the attention of the people down at Washington who had so much to say of Garland and the Pan-Electric. Edmunds is the general solicitor and R. C. Dun, the Commercial Agency man, is the president. The people who put up the money for the Overland are C. M. Henderson, the boot and shoe man; the Keiths, the Pecks, the Seips, the brewers; Wampold, the wholesale clothier; the Loebs, the real-estate men; F. G. Logan, of the board of trade; Michael Brand, the brewer, and Fuller, the planing-mill owner.

Lawyer C. L. Bonney is largely interested in the Pratt & Plumb patents. John H. Hamlin, of the Grand Opera-House, has put more cash into it than any other. Elsworth, the coal man, and Nolan, of the Mutual Accident Life Insurance Company, are also interested. The Drawbaugh patent is controlled by the Seligmans, the Hebrew bankers at New York. Lazarus Silverman, the banker, is the only one here who is largely interested. It is owned and being pushed by a Hebrew syndicate. It is apparent from these lists that there are men who are interested in several of the opposition companies. The truth is that just now all the fighting companies are exceedingly friendly. How long that would last when once they were in the field against each other is not hard to tell.

It is part of the telephone history that the Bell right, here at Chicago, was offered to C. B. Farwell for $25,000 and afterward to Louis Huck, the maltster. That was in 1878. Two years later it could not have been bought for $1,000,000.

Central Union telephone stock is advancing. I quoted this stock in the issue of Feb. 5 at 48 and 49. I notice that the quotations which Colonel Lynch furnishes me to-day places the stock at 53 to 54. The repeal of the Indiana low-rate law will give further impetus to the advance in the price of this stock.

Mr. W. H. McKinlock, well-known from his connection with the Detroit Electrical Works, was a caller at my office this week. Mr. McKinlock is accompanied by his brother, Mr. George A. McKinlock. They are searching for a suitable store in Chicago, which, as soon as found, they will stock up to the ceiling with a full line of general electrical supplies.

At an adjourned meeting of the City Council held last night, the Committee on Fire and Water reported in favor of an appropriation of $75,000 for an electric lighting plant for lighting the river between Chicago avenue and Halsted street. The matter was made a special order for a week from Monday.

Edward P. Allis & Co., of Milwaukee, manufacturers of the well-known Reynolds improved Corliss engine (specially adapted for electric light work) have in preparation a very handsome and complete catalogue of engines, which will be issued shortly. They have also just issued in very attractive form a pamphlet giving a list of users of the Reynolds-Corliss engine. Both the catalogue and the pamphlet will be mailed to those of your readers who may ask for them.

Buffalo, N. Y., is to have a multiple switch-board. The order has just been put in with the Western Electric Company, and calls for an equipment for 1,500 lines, and an ultimate capacity for 4,000 lines. The Western Electric Company are also in receipt of an order for a 100 number annunciator for the River View Hotel, Kankakee, Ill. They have also sold a 50-lamp electric light plant to go to Kankakee, and another 70-light plant for St. Louis.

Mr. George J. Fritz, of 2,026 South Third street, St. Louis, Mo., patentee and builder of the electric light engine bearing his name, made during February the following shipments of these engines and other apparatus: One 4 h. p. engine, with boiler combined, to Los Angeles, Cal.; one 8 h. p. engine, with boiler combined, shafting, pulleys and outfit complete, St. Louis; one 3 boiler patent eccentric doctor to Jenney Electric Light Company; one 6 boilor patent beam docter for St. Louis; one 2 boiler patent eccentric doctor to Clarksville, Mo.; one 6 h. p. engine to St. Louis book bindery; one 4 inch relief valve to large cotton compress, Wilmington, N. C.; one new governor and lot pulleys, shafting and supplies to mill in Texas; one 2 boiler patent eccentric doctor, with double-acting cold water pump, to Werner, Miller & Co., Wright City.

A dispatch from Centralia, Ill., dated March 3, says that at Odin a "cub" who had been learning telegraphy took a train order, and, without telling the regular night operator about it, went to church. The section of 51, west-bound on the Ohio & Mississippi, came along, and was given nothing but working orders. When within a mile of Sandoval it collided with a special east-bound. The engineers and firemen jumped in time to save their lives, but the engines and several cars were completely demoralized. The company has issued an order discharging all "plugs" in all telegraph offices along the entire line. The order is rigid, and no learners are allowed on the company's premises.

In my last letter I spoke of the Wirt voltmeter, furnished by the Electrical Supply Company, No. 171 Randolph street, Chicago. Referring further to this instrument, I will say that it is direct-reading, no special skill being required for its use. It is claimed that its accuracy is not affected by temperature or proximity to dynamos or currents. For testing the E. M. F. of arc or incandescent machines, batteries or accumulators, this instru-

ment seems to be all that can be desired. Unsteady, undulatory and intermittent currents can, I am informed, be measured by this instrument with perfect accuracy. These conditions give rise to serious errors with unreliable voltmeters. The Wirt instrument can also be used for testing insulation and measuring resistance. Where no special apparatus for such purpose is at hand this feature of the instrument becomes a very valuable one. The Electrical Supply Company find a steadily increasing demand for these voltmeters.

Mr. Wm. Hubbard, of the Elgin (Ill.) Telephone Company, favored this office with a call to-day. Mr. Hubbard is lately back from Philadelphia, where he exhibited his excellent apparatus to the visitors at the Electric Light Convention. You illustrated the apparatus there exhibited in your issue of the 5th inst. Mr. Hubbard is highly pleased with the results of his eastern trip, and reports business good.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes me the following telephone stock quotations :

Bell of Mo.	$155@$157
Central Union	53@ 54
Chicago	375@ 400
Colorado	20@ 22
Cumberland	80@ 85
Great Southern	30@ 33
Michigan	71@ 73
Rocky Mountain Bell	40@ 45
Wisconsin	104@ 106

W. A. K

PACIFIC SLOPE NOTES.

SAN FRANCISCO, Feb. 17, 1887.

The Western Electric lighting plant at San Bernardino, Cal., is to be turned over next week to the stock company formed for that purpose. It is now run by a 60 h. p. engine, but is to be transformed into a water-power plant this summer. The same power is to run an electric railway of 14 miles, from Riverside to San Bernardino, and a street car line in Riverside. It is also to furnish power for the lighting of Riverside, Colton, and hotels along the line of circuit.

The San Francisco Electric Construction Company is doing a large share of the electric lighting work around California, Oregon and Washington Territory.

Mr. R. A. Simon has resigned his position as electrician of the steamer "Santa Rosa," to start in business for himself.

Oreville, Cal., is to have an electric light plant for its streets.

Santa Barbara, Cal., is almost ready to light up with its Thomson-Houston plant.

The steamers "Orizaba" and "Ancon" were taken off of the southern route because all the passengers would rather wait for the steamer "Santa Rosa," on account of the electric light (Edison incandescent) burning all night. The steamer "Queen of the Pacific" has been put in their place. She has an Edison plant of 250 eight candle-power and a Weston headlight.

THE TELEGRAPH.

T. M. B. A.—Mr. C. P. Bruch, the secretary, announces that as the treasurer has enough funds to meet all claims, the executive committee has voted to pass the monthly assessment issuable on March 1, and to levy the next assessment on April 1.

Mexican Government Telegraphs.—The Boston *Herald* of Feb. 27 gives a very good account of the work done by the Government Telegraphs of Mexico, under the direction of Gen. Carlos Pacheco, minister of public works, and Mr. Saturnino Islas, general manager of the telegraph system.

For the Adirondacks.—The Adirondack, Lake George and Saratoga Telegraph Company has filed a certificate of incorporation with the New York Secretary of State. It has a capital of $100,000 in 2,000 shares. The route will include North Creek, Warren County; Lake Placid, Essex County, and Paul Smith's, Franklin County. The incorporators and shareholders are J. J. Barry and Herbert Smith, of New York, and Uriah M. Osborn, of Rahway, N. J.

The B. & M. Property.—A dispatch of Feb. 24, from Cleveland, O., says: "An action to set aside the sale of the Ohio property of the Bankers & Merchants' Telegraph Company, permitted by the Common Pleas Court of this county, was heard yesterday, in the State Circuit Court. The sale of the property was ordered here in 1885, to provide for the payment of a debt of $130,000. The claim was in certificates issued by R. S. Newcomb and J. G. Smith, receivers of the company. An objection to the sale was made by Receiver Harland, of the American Rapid Telegraph Company, which was defeated, and the property was sold to Edward S. Stokes, of New York, for $65,000. Harland gave notice of the contest at the time, and arguments were heard yesterday. Colonel R. G. Ingersoll appeared for Stokes. The case was taken under advisement by the court."

THE TELEPHONE.

Manitoba.—The report that the Manitoba Telephone Company has been bought by the Bell Telephone Company of Canada is denied by the latter.

Newark, N. J.—A special dispatch of March 1 says: Samuel Klotz handed to the Domestic Telephone Company to-day a check for $200,000 as purchase money for the stock and plant of the corporation for the New York and New Jersey Telephone Company.

Motion to Amend the Plea.—Counsel for the defendant in the case of the United States Court against the Bell Company has filed a motion for leave to plead certain facts in addition to the demurrer to the bill. The company also wants to plead any and all determinations relating to or affecting the validity and scope of said patents.

Telephone Stock.—Bell telephone rose above all other stocks or from 216 to 224, says the Boston *Herald* of March 4. Orders at top figures were soon filled, and reaction to 219 followed. Current gossip relates to an extra dividend, which is expected by and by, say after the Legislature adjourns, if not earlier. The company is earning some 23 per cent., and could pay 8 or 10 per cent. extra if it chose. The last extra dividend was 4 per cent., in July, 1886. New England telephone was more active than usual, at 44 @ 44½, a gain from 48⅝. Mexican lacked sale, but is reported sharing in the growing prosperity of Mexico.

THE ELECTRIC LIGHT.

Sparta, Wis.—A plant is to be put in by G. D. Dunn and others.

Vinton, Ia.—An electric light plant will be put in by S. H. Watson and his associates.

Canton, Ill.—The People's Gas and Electric Light Company will put in an electric light plant.

Saratoga, N. Y.—The Saratoga Victory Manufacturing Company, Schuylerville, is fitting up for electric lights.

Atlantic City, N. J.—The Atlantic City Gas & Water Company, Mr. John Roberts, President, is to do some electric lighting.

Greenport, L. I.—An electric light and power company has been incorporated in the village of Greenport with a capital stock of $12,000.

Quincy, Ill.—The electric light station at Quincy was destroyed by fire on March 2. The apparatus is somewhat damaged but the boiler and engine are uninjured. The plant consists of 225 Thomson-Houston arc lights. The loss is fully covered.

Braddock, Pa.—The Citizens' Electric Light Company has been incorporated by W. A. McDevitt and others, with a capital stock of $10,000.

Greensburg, Kan.—The Greensburg Electric Light Company has been incorporated by C. W. Myers and others, with a capital stock of $100,000.

Idaho Springs, Col.—The Idaho Springs Electric Light Company has been incorporated by A. W. Horn and others, with a capital stock of $10,000.

Chicago, Ill.—The Northwestern Electric Light and Lighting Company has been formed by G. F. Lanahen and others with a capital stock of $200,000.

Cairo, Ill.—The Thomson-Houston Company, of Boston, has been given an order for a complete station plant of 70 arc lights, including engine, boilers, etc.

Chicago, Ill.—Mr. J. S. Woodruff and others have incorporated the Burdett-Loomis Gas and Electric Light Company, with a capital stock of $100,000.

Altoona, Pa.—The Mountain City Electric Light and Illuminating Company has been incorporated by E. T. Dunn and others with a capital stock of $10,000.

For the New York Elevated.—A bill has been introduced in the New York Legislature, the object of which is to compel the New York elevated railroad people to place electric lights along their tracks at intervals of 300 feet.

North Attleboro, Mass.—The North Attleboro Electric Light Company have received their boiler and one of their new Armington & Sims Co. engines; also the iron stack. The contract for enlarging this station has been awarded to the Jarvis Engineering Company, Boston, Mass.

The Suez Canal.—The first steamer which has made the passage of the whole length of the Suez Canal by aid of the electric light has just accomplished the trip, and took only fifteen hours to do it. This is an immense economy of time, the trip often taking two days under the old conditions.

Windsor Castle.—The electric light, which was introduced sometime back into several of the State apartments at Windsor Castle, has now been extended into the residential portion, and the grand corridor, the three drawing-rooms (the white, the green, and the crimson), the great dining room, and the oak room are all fitted with it. This improvement has been brought about by Sir John Cowell.

Woonsocket, R. I.—The State Senate Committee gave a hearing recently on the petition of the Woonsocket Gas Company to amend its charter so as to do an electric lighting business. The petition was opposed by the Woonsocket Electric Light and Power Company, which has a paid up capital of $50,000 and is now running 80 arc and 500 incandescents. The plant was established in 1883 and the company is about to erect a new station to meet the demands of a growing patronage.

Increase of Plant.—The Western Edison Electric Light Company have taken out the electric light dynamos from the Chicago City Hall, which they put in about a year ago, and are replacing them with dynamos of larger power. The original plant had a capacity of 1,400 lamps of 16 candle-power each, while the new one is to operate 2,100 lamps. The reason for the increase is the large number of lights put into the Public Library rooms on the fourth floor, and the extra number placed in the lobbies.

New Orleans, La.—A special dispatch of Feb. 28 from New Orleans says: On Jan. 22 last the shot tower of the Gulf Shot and Lead Company caught fire and was gutted. The blaze was a magnificent spectacle. The tower was 200 feet high, and the flames shot up a hundred feet in the air, making a column of fire visible off in the Gulf of Mexico. It was alleged that the fire was caused by the improper insulation of the electric wires. To-day the Gulf Shot and Lead Company entered suit against the Brush Electric Light Company for $17,100 damages resulting from the fire.

Boston, Mass.—The enlargement of the Edison Illuminating Company's station is progressing rapidly. Four 15½ × 15 double disc Armington & Sims engines have been placed in position, a new Davidson pump has been put up, and a large No. 15 National feed water heater will be connected this week. As soon as the new engines are started, the old ones will be removed to the new position, and four large steel tubular boilers will be set. The new chimney will be erected at once and will be large enough to run 2,000 h. p. of boilers. The entire work will be under charge of the Jarvis Engineering Company.

Worthy of Liberty.—Mr. E. H. Goff, president of the American Electric Manufacturing Company, whose system is used in lighting the Statue of Liberty, has sent us a most sumptuous and beautiful banner on which is certainly the finest engraving of the statue that has yet been published. The banner measures 21 × 30 inches. It is of white satin, richly bordered with gold lace and bullion fringe, and at the top has a brass rod and chain by which to be suspended. Altogether it is a really notable piece of art work. We are much obliged to Mr. Goff, and have given the banner a very conspicuous place in our office.

Lighting with Leclanche Cells.—M. Eugene Alliot, of Chateaurenault, employs a battery of eight Leclanché elements with which he occasionally lights up a couple of small glow lamps for a couple of minutes at a time. Owing to the rapid polarization of the battery, it is, of course, impossible to get a full light for more than a few minutes. It, however, occurred to M. Alliot to try to "regenerate the zinc and the di-oxide of manganese" by means of a reversed current. By sending the current from a small dynamo through the cells once a week, for only a few minutes at a time, it was found that the Leclanchés did not tend to polarize when feeding the lamps nearly as quickly as before.

Albany, N. Y.—Articles of incorporation have been filed with the New York Secretary of State of the Albany Edison Illuminating Company. The objects of the corporation are to manufacture and use electricity for producing light, heat and power, and supplying and selling the power. Also for manufacturing, supplying and selling steam for heating purposes. The capital stock is $250,000, in shares of $100 each. The following are the trustees: Hon. Henry R. Pierson, James W. Eaton, Thurlow Weed Barnes, James M. Warner, James McNaughton, Edgar Cottrell, Howard L. Browning, John H. Farrell, Frank S. Hastings, W. J. Arkell. The company will soon establish works to provide factories, stores and private residences with the Edison light.

A New Dynamo for Lighting.—Joshua Gray, whose workshop is on Chardon street, thinks he has devised a better dynamo-electric machine than any other now in use. Mr. Gray has gone out of the beaten ruts and invented a unique type, and so has at least the chance for the remarkable success he expects. Instead of having the field wholly outside of the armature, he has one pole without and one within, a cylindrical frame of electro-magnets being wound to make one pole, and a solid core making the other. Between the core and solid frame rotates a frame carrying six armatures (there may be eight or ten if desired), each of which revolves as the frame rotates. Thus the armatures never leave the faces of the magnet, but roll over them. No measurements have yet been made of the power used and the current gained, but with an inch belt furnishing the power, enough current is produced to light 200 incandescent lamps. Mr. Gray argues that this is wonderful lighting for the power that can be carried by an inch belt.—*Boston Globe.*

Thomson-Houston Lights in Sweden.—We have received an interesting letter from a well-informed correspondent at Hernosand, Sweden, speaking in the highest terms of the Thomson-Houston plant there. Our Swedish friend says: "The plant has been running since Dec. 10, 1885, for street lighting, without one second of trouble or darkness. It has so pleased the authorities and people here that they now intend to introduce the Thomson-Houston incandescent system for the Town House, Merchants' House and schools, and for private users as well. It will be ready by Aug. 1, 1887. We are using to-day the first brush set on the commutator, and the first commutator ran 6½ months without need of turning off. We operate the lights from 3:45 P. M. to 12:15 A. M. We have darkness at 4 P. M. We have not had to repair anything in our system, not so little even as for half a cent. The town of Tammerfors, Finland, where there is much water-power, proposes to introduce the Thomson-Houston system. Wexio, Sweden, has now introduced the united arc and incandescent light with steam-power, and I have seen in the newspaper that Malmo, a town in the South of Sweden, is to have electric street lighting, with steam-power." Our North Pole correspondent has our warmest thanks for his news, and heartiest good wishes for his further success.

APPLICATIONS OF POWER

The Bidwell Company, of Chicago, is reported to be preparing to equip some new electric roads in Indiana, Illinois and Michigan.

Orange, N. J.—The Daft railway in course of construction at Orange is now in a well advanced state, and will probably be ready to operate by May.

The New York Underground has just made application to Public Works Commissioner Newton for permission to open the surface of the streets under which its main line is located in order to begin the work of construction. The officers state that there is no legal obstruction to the road, and that all the cash necessary to begin work is on hand. A company has been already formed for the construction of the road, which includes Messrs. Adolph Ladenburg, Edward P. Beach, R. W. Cameron & Co., John M. Crane, Richard Irvine & Co., August Belmont, Jr., John H. Cheever, Henry Clews, Jonathan H. Crane, John H. Davis & Co., Robert B. Minturn, James T. Woodward, Alexander H. Stevens, David H. Bates and J. Coleman Drayton. The route of the main line extends from Broadway, at City Hall Park, under Park Row, Centre and Mulberry streets, to Lafayette Place, to Union Square, where two lines will start, one under Madison avenue to the Harlem River, and the other under Broadway to Central Park. It is stated that as soon as a permit is obtained the work can be begun and that it can be done within a year. The excavations are to be twelve feet six inches below the curb line. The officers say they anticipate no opposition from the property owners because of the comparatively slight depth of the excavations. The application for a permit has been referred to the Corporation Counsel for his opinion.

Preference for the Electric Motor.—The *American Inventor*, of Cincinnati, a large monthly paper, with extensive printing offices, has been using a Sprague motor since last October. In its last issue it says: "A motor of two horse-power was accordingly bought, set up, and started Oct. 26, 1886, and has been running almost continually ever since, for at least nine hours daily, and, whether driving one or all four presses at the same time, the speed is as perfectly regular as could be desired. Aside from the small amount of care required to keep the brushes and commutator in good working condition, nothing has been done to the machine since it was first started. If the steam or gas engine

is a success, the electric motor is also a success. It is cleaner safer, less costly and easier managed than any steam, air or gas engine in existence. It occupies but little space, a two horse-power requiring a floor space of 24×30 inches, and a height of but sixteen inches. Since our motor was started, a number of others have been introduced in various parts of this city, to replace both steam and gas engines for running printing presses, paper-cutting machines, elevators, etc., and in every instance they have given perfect satisfaction, being always ready, day or night, to develop a part or all of their power, as occasion may require."

An Enos Road for Los Angeles.—The Enos system, in which the cars are suspended from the track, has been adopted for a new road in Los Angeles, by the American Rapid Transit Company, which has a capital stock of $500,000, for which $300,000 is already subscribed. The object of the company is to construct lines in Los Angeles, San Diego and San Bernardino counties. The directors are: Gen. H. G. Rollins, of Los Angeles, formerly Surveyor-General of California · T. R. Bennington, of Los Angeles; J. K. Mulkey, of Los Angeles; D. Gilbert Dexter, of San Diego; A. E. Clark, vice-president of the Clark-Bryant Improvement Company, of St. Paul, Minn., an important incorporation with a paid-up capital of $100,000; and Dr. J. H. Bryant, president of the same concern. The motive power for the system is electricity, motors being used in the truck above the guides of the line. It is expected that part of the road will be running within six months.

MISCELLANEOUS NOTES.

Appreciative Words.—THE ELECTRICAL WORLD, devoted to electrical pursuits and electrical matters in general, is the largest paper of the kind published. Its last issue contained forty-eight pages, of which sixteen were entirely devoted to reading matter. To those interested in electrical matters and in the pursuit of scientific knowledge, it is a most valuable paper.—*New York Daily News.*

Mill Engine Safety Device.—Some of the mills in Fall River are putting in a new safety device for stopping the engines from any part of the mill. An electric wire runs from the engine to each room in the mill. There is a box in each room, from which, by the simple turning of a key, the engine may be instantly stopped. This device is designed for use in case of accident in any part of the mill, rendering it necessary to stop the machinery. The boxes are sealed to prevent their use except in case of emergency.

An Underground Pole Line.—The superintendent of the Winona & St. Peter Railroad states that between Mankato and Tracy the snow drifts are in many cases six feet above the telegraph poles, and that the linemen have had to splice scantling to the tops of the poles to get the wires up where they could be used. He says that many of the drifts are twenty-five feet deep, and packed so hard that the company dares not attempt to send a snow plough through them. One thousand men are now at work shoveling snow between Mankato and Tracy, and the line will not be clear for several days.

Western Union Sued.—A dispatch of Feb. 28 from Manchester, N. H., says: "The city to-day brought suit against the Western Union Telegraph Company in the sum of $3,500 and costs, the amount of a verdict rendered against the city by reason of telegraph poles falling in the highway, and which was the cause of an accident to Mrs. Eliza Sykes, of Hooksett. The city summoned in the telegraph company as the next defendant and permitted the case to go by default, and now seeks to recover the amount of the verdict from the company. The papers were served on Charles J. Abbott, manager of the telegraph office in this city."

Secondary Generators.—The next meeting of the American Institute of Electrical Engineers will be held at Cable's restaurant, 130 Broadway, on Tuesday, March 15. Dinner will be served at 6 P. M. The subject for the evening will be "Induction and Secondary Generators." Mr. Philip Diehl will exhibit his ingenious induction system, and special addresses are promised by leading members. Altogether a most enjoyable and profitable evening may be expected. The subject of secondary generators or transformers is now occupying general attention, and there is much anxiety for information in regard to the theory and practice.

The Art of Electro-Metallurgy was the subject of an interesting paper read before the Buffalo Electrical Society on Feb. 5, by A. C. Terry, Repeater Chief of the Western Union Telegraph Company. The earliest observations on the deposition of metals by electrical agency, he said, were made by Wollaston in 1801, soon after the discovery of the voltaic pile; and these were followed some years later by other discoveries, which, however, were put to no practical uses until 1839, when Jacobi, of St. Petersburg, Spencer, of Liverpool, and Jordan, of London, independently described the process of depositing copper upon other metals by means of electricity. Then followed the discovery by Murray of the use of plumbago, or black lead, for giving non-metallic bodies a conducting surface, so that impressions of an original can be taken in wax, plaster of Paris, etc., which are then covered with powdered plumbago upon which the metallic deposit is subsequently made. In 1840 electro-plating began to be carried on extensively by the Elkingtons, of London, and afterward by Christofle & Co., of Paris, and it is said that the latter firm annually deposits 13,000 pounds of silver, and that since the establishment of the house in 1842, upward of 185 tons of that metal have been used in electro-plating.

SPARKS AND FLASHES.

Square and Round.—The telegraph messenger boys in New York complain that they "ain't used square." And yet they show a decided objection to being round when they are wanted.—*Boston Transcript.*

PERSONALS.

Mr. Chas. B. Goodell has been appointed agent of the Telegraphers' Mutual Benefit Association at Ogden, Utah, vice E. D. Flanagan, resigned.

Mr. B. F. Dillon has been appointed agent of the Telegraphers' Mutual Benefit Association at Jacksonville, Fla. Mr. Dillon resigns the Western Union managership at Savannah to take the superintendency of the I. O. T. Co.'s lines, with headquarters at Jacksonville.

Mr. T. A. Edison.—Many things are said about Fort Myers, Florida, on account of its being the winter residence of Thomas A. Edison, the inventor. In spite of its prominence it is a very small town, having less than 300 inhabitants an no railroad within many miles of it. Major F. S. Henning, who is thoroughly conversant with Florida, said the other day that Fort Myers is one of the most remarkable villages in the country, being so far in advance of civilization over anything in the way of a frontier town as to cause comment to that effect by every one who visits it. The people are all intelligent, educated and moral. There are no saloons and they have crushed out every bad element. Edison's place is a mile away from the village. He has a laboratory there and a large workshop where he pursues his experiments in electricity. His villa and grounds are lighted with electric light. Recently he offered to light the town with electricity if the citizens would contribute the necessary funds to put up the poles and wire, which they did, and now the road leading to his house, as well as the little village, is nightly illuminated as brightly as any place in New York.

BUSINESS NOTICES.

Free to Electric Light Co. or any Engineer.—Enough "Eureka" packing to pack a box. Guaranteed superior to anything on the market. 75c. per lb. HINE & ROBERTSON, 12 Cortlandt St.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Feed-Water Heaters.—The Wainwright Manufacturing Company, Boston, Mass., report shipments during the month of February of their feed-water heaters to the following places: Three in Boston, 1 to Chelsea, 1 to Lawrence, 1 to Ayer, 1 to Forge Village, Mass.; 1 to Keene, N. H.; 1 to Wilmington, Del.; 1 to Newark, 1 to Gloucester, 1 to Millville, 1 to Paterson, N. J.; 2 to Washington, D. C., and 1 to Palatka, Fla. Their corrugated tube radiators having been sent in such opposite directions as Maine and Oregon. The company consider that they have no right to complain of the present aspect of business, but are preparing for a busy and successful spring trade and catching up with the accumulation of their winter orders.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks:

March 8, 1887.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	.....	37
Am. Tel. & Cable	71½	73
Cen. & So. Am.	95	100
*Com. Tel	.....	.....
*Gold & Stock	93	.....
*Inter. Ocean Tel.	93	.....
N. Y. Mutual	70	75
Pac. & Atl.	47	54
*Postal T. & C.	25	35
South. & Atl.	60	.....
W. U. Tel.	77½	77⅝
W. U. Scrip.	72	73
W. U. Bonds	118½	119
Mut. U. Bonds	86	87
TELEPHONE.		
Am. Bell	223	224
Am. Speaking	110	120
Erie	28¾	29
*Hudson River	60	65

TELEPHONE.	Bid.	Asked.
Mexican	1⅝	1⅞
*N. Y. & N. J.	91½	93
N. Y. & Pa.	.....	.....
New England	44	44½
*Southern Bell	.....	150
ELECTRIC LIGHT.		
*Am. Electric	.....	.....
*Brush	.....	.....
*Brush Ill	.....	.....
*Consolidated	.....	.....
*Daft	.....	.....
*Edison	.....	.....
*Edison Ill	95	107
*Edison Isolated	.....	.....
*United States	35	.....
*U. S. Ill	95	100
MOTOR.		
*Daft	.....	.....
*Sprague	.....	.....

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED FEB. 22, 1887.

(1) **358,019. Electric Battery Jar**; (2) **358,386. Electric Battery**; F. B. Crocker and C. G. Curtis, New York, N. Y., Assignors to the C. & C. Electric Motor Co. Applications filed March 29, 1886. (1) A handle and nose for each jar is provided, whereby convenience in handling is accomplished. (2) The negative element is formed of two parallell walls, having openings or passages therethrough, a continuous conductive support for the walls, and a positive element, consisting of a solid plate, interposed between and insulated from the walls of the negative element and sustained by said support.

(1) **358,030.** (2) **358,031. Galvanic Cells**; W. Frishmuth, Assignor by direct and mesne assignments, to R. De Montgelas, W. H. Gaw, J. H. Clark, R. Ellis, H. Jungerich, and George C. Potts, all of Philadelphia, Pa. Applications filed Oct. 20, 1886. These inventions consist in supplying aluminium connections for the negative electrode.

358,043. Transmitting Gear for Electric Motors; W. H. Knight, New York, N. Y. Application filed April 7, 1886. Specifically, this invention consists in a reciprocating device to which motion is imparted by the motor, and which imparts motion to the driven mechanism by a step-by-step action.

358,053. Electrical Pumping Apparatus; M. A. Michales and A. Michales, of Pittsburgh and Allegheny, Assignors of one-fourth to J. B. Sneathen, of Pittsburgh, Pa. Application filed Aug. 20, 1886. A pumping apparatus having in combination a stationary dynamo and a portable pump provided with an electric motor detachable from the pump.

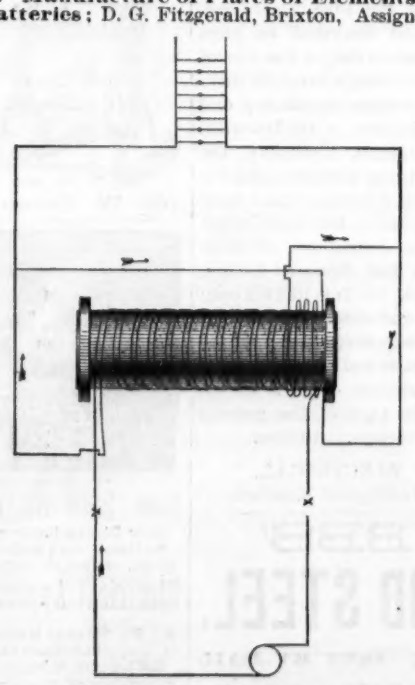
358,087. Galvanic Battery; W. H. Tasker and T. J. Jones, London, Assignors to the Primary Battery Co., Hanover Square, England. Application filed April 22, 1886. The support is constructed of gutta-percha, celluloid or equivalent non-conducting and inoxidizable substance, to which strips or flattened wires of conductive inoxidizable material (preferably gold or platinum foil) are applied in such manner as to be retained securely in place and at the same time make efficient contact with the active material.

358,092. Secondary Battery; J. T. Van Gestel, New York, N. Y. Application filed June 9, 1886. The intention is to furnish a battery which is not liable to be injured or disarranged by handling or transportation, and the electrodes or elements of which are so constructed as to render their charging and discharging more complete and regular, and also that the accidental fracture of a plate will not stop its action or interfere with the working of the battery.

359,095. Manner of Making and Cooling Joints for Electrical Conduits; B. Williams, Chicago, Ill. Application filed Nov. 2, 1886. After the joints have been sealed in with hot cement they are cooled by introducing water.

358,109. Electric Push-Button; A. G. Davis, Baltimore, Md. Application filed June 16, 1886. A base is provided, to which is screwed a metallic cap or cover carrying the plunger.

358,111. Manufacture of Plates or Elements for Voltaic Batteries; D. G. Fitzgerald, Brixton, Assignor to the



358,415. INDUCTION COIL.

Primary Battery Co., of Hanover Square, England. Application filed April 16, 1886. Briefly stated, the invention consists in mixing oxide of lead with a soluble salt which will decompose and form with the oxide of lead an insoluble compound, and in finally dissolving out the residual base, leaving the mass porous.

(See article entitled "Lithanode," E. W., Oct. 2, 1886.)

358,116. Machine for Straightening Rails; A. J. Gustin, Boston, Mass. Application filed Aug. 4, 1883. Electrical devices are employed for determining and regulating the amount of pressure to be brought upon a rail by the anvils and plungers to bring it straight and true.

583,120. Voltaic Battery; T. J. Jones, Hanover Square, England, Assignor to the Primary Battery Co., of same place. Application filed April 24, 1886. The invention consists in making those parts of a battery which serve to support and make contact with the active material of an insulating inoxidizable material, in imbedding therein a conductor, and in putting the conductor into electrical connection with the active material of the element at several points by the intervention of gold or platinum, applied in such a way that there is obtained all or nearly all the obvious advantages, as regards efficiency, of a support constructed wholly of these precious metals.

358,133. Regulator for Dynamo-Electric Machines; F. Vivó y Graells, Barcelona, Spain. Application filed Jan. 8, 1887. The intensity of the current is regulated by an apparatus which regulates the speed of the dynamo according to the resistance of the circuit as it increases or decreases.

(1) **358,140. Cable Hanger**; (2) **358,250. Telephone Annunciator**; J. A. Barrett, Brooklyn, N. Y., Assignor of the former to the Western Electric Co., Chicago, Ill. Applications filed, respectively, Dec. 15, 1883, and Dec. 7, 1886. (1) This device consists of a flanged sleeve, which embraces the conductor, and a wire bent around the sleeve and passing through the flange and over the support in the form of a hook. (2) Besides the ordinary magnet and its arrangement of armature, shutter lever and shutter, there is provided a branched circuit, one part of which passes through the magnet and the other through a constant resistance and through the armature, and its back stop to constitute a shunt for the magnet.

358,145. Arc Lamp; W. A. Crowdus and H. M. Sutton, Dallas, Texas. Application filed Oct. 1, 1887. Improvements in the feeding mechanism, the cut-out, the clutch, the carbon-holder, and in minor details are here proposed.

358,161. Electric Gas Alarm; W. McVay, Quincy, Ill. Application filed June 19, 1886. The object is to provide a simple device for establishing an electric circuit when the gas flame is extinguished, and for breaking the circuit and holding it open while the gas flame is burning.

358,309. Switch-Board for Electric Light Systems; G. H. Warde, Brooklyn, Assignor of one-half to A. MacGruthar, of New York, N. Y. Application filed May 15, 1886. The object is to allow the use, with one single system of house-wires, of either the arc or the incandescent system of electric lighting, and of a change at will from one to the other without change in the wiring of the house.

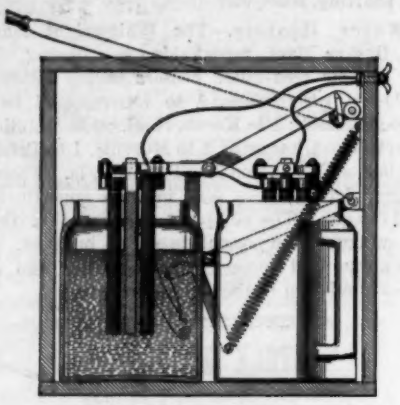
358,314. Electric Battery; S. S. Wheeler and C. G. Curtis, New York, N. Y., Assignors to the C. & C. Electric Motor

Company. Application filed Aug. 14, 1886. The object is to provide means for conveniently raising and lowering the electrodes and setting them at any desired depth of immersion by means of a handle or lever, and to enable this to be done in such a way that when the hand is removed from the handles, the electrodes will remain fixed at the point and immersed to that extent. [See illustration.]

358,317. Telephone Exchange System; G. L. Wiley, Elizabeth, N. J., Assignor to the Western Electric Manufacturing Co., of Chicago, Ill. Application filed Dec. 13, 1880. Two or more lines extending from a central station to two or more sub-stations, a transmitting telephone connected with each of said lines at its sub-station, and a receiving telephone at the central station included in an earth-wire which normally completes the circuit of all the sub-station lines, constitutes the invention.

358,336. Automatic Fire Extinguishing Apparatus; E. T. Copeland, Brooklyn, N. Y. Application filed May 12, 1886. The water valves are sealed with soft solder. The solder is surrounded by wicking in which is imbedded a fine wire which may be brought to incandescence by an electric current and fire the wick. The heat will melt the solder and allow escape of water.

358,340. Dynamo; R. Eickemeyer, Yonkers, N. Y. Application filed March 2, 1886. There is provided an armature, an exciting-helix surrounding the armature, and an inclosing shell of magnetic metal, polarized by said helix to form pole-faces of opposite polarity, and affording a magnetic circuit, which is cut by the armature-conductors alternately in opposite direc-



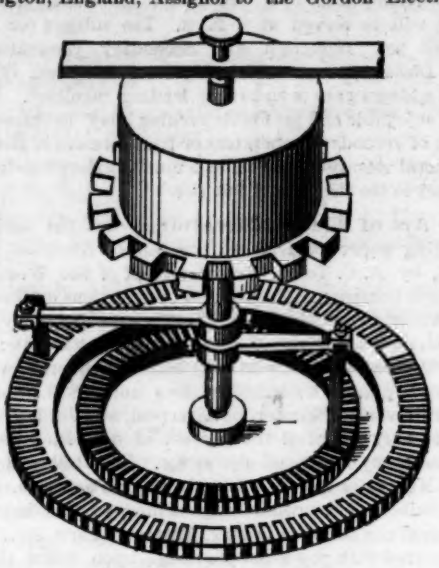
358,314. ELECTRIC BATTERY.

tions during the rotation of the armature. [See page 132 this issue.]

358,341. Storage Battery; C. P. Elieson, London, Eng., Assignor to the Electric Locomotive and Power Co. (Limited), of same place. Application filed May 18, 1886. The first claim sets forth the invention as follows: An electrical accumulator, consisting of a frame of lead or other suitable material, containing spirals of sheet lead, whose surfaces are separated by suitable insulating and acid-proof material, substantially as described. [See illustration.]

358,343. Armature for Electro-Magnets; C. A. Gaiser, Edwardsville, Ill. Application filed March 13, 1886. This inventor has provided an armature for an electro-maguet consisting of one or more thin sheets of metal set in planes parallel with the axis of the magnet cores, the sheets being made to pass outside of the cores without contact with the latter, and an auxiliary loop or ring located opposite the head or cores, said coil being connected with and forming a part of the armature, but leaving open spaces for the inspection and adjustment of the core and armatures.

358,346. Electric Lighting System; J. E. H. Gordon, Kensington, England, Assignor to the Gordon Electric Light



358,379. TELEGRAPHY.

Company, of America (Limited), Philadelphia, Pa. Application filed Aug. 21, 1886. Means are provided for automatically keeping the electromotive force on a distant part of the line constant without regard to change in the E. M. F. at the generator.

358,350. Electro-Magnetic Thermoscope; H. J. Haight, New York, N. Y. Application filed June 17, 1886. The invention embraces the following combination: The main index, the high and low temperature limit indexes insulated from one another, and high and low temperature electric circuits, the high and low temperature indexes being in the said electric circuits, and the main index being in part of a circuit common to both the other indexes and adapted to close either circuit by being brought into metallic or electro-conducting connection with one of the other indexes.

358,357. Mechanical Telephone; J. S. Jones, New York, N. Y. Application filed June 19, 1886. There are provided two diaphragms which are at some distance from each other, but connected by a series of fine wires. The diaphragms are set so that they will directly receive the sound waves.

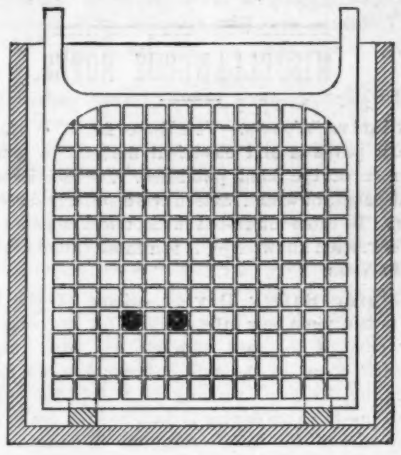
358,360. Electrical Mail Indicator; V. A. Krepps, New York, N. Y. Application filed May 12, 1886. This invention has for its object the construction of a suitable indicator which will, whenever a letter is dropped into the mail box, show that there is mail in the box for the person in whose office or room the indicator is placed.

358,379. Telegraphy; R. G. Brown, Brooklyn, Assignor to the Standard Multiplex Telegraph Company, of New York. Application filed April 20, 1886. The objects sought to be attained by this invention are the independent operation of a number of printing instruments over one wire at practically the same time; to run such instruments at different rates of speed, according to the requirements of each circuit; to have but one main battery at each station, and this battery situated at the central office of the main line; to provide for the location in the central office of the principal relays of the various operators, together with their local batteries, etc., to run the type wheels of the various instruments locally from the terminal or main office and independently of the main line; to transmit a current over the main line only when it is desired to take an impression from the type-wheel; to make use of but one wire for connecting each printing instrument with the main or central office, and to provide each instrument with a unison device by means of which the corresponding printers may be brought to unison. [See illustration.]

358,393. Fire Telegraph; J. H. Guest, Brooklyn, N. Y. Application filed Nov. 13, 1886. The object sought to be accomplished is to provide devices whereby a warning will be given in case of the accidental breaking or grounding of the circuit employed.

358,415. Induction Coil; M. M. M. Slattery, Woburn, Mass., Assignor to the Sun Electric Co., of Maine. Application filed Sept. 24, 1886. This induction generator consists of a primary coil, a secondary coil and a regulating coil all wound upon the same core but in different directions, by means of which the coil is made self regulating. [See illustration.]

358,417. Electrical Door Opener; L. P. Summers, Ormond, Florida, Assignor to P. and F. Corbin, New Britain, Conn. Application filed Sept. 1, 1886. Peculiar electrical de-



358,341. STORAGE BATTERY.

vices are provided for opening the main door of a building from any floor of the building.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.

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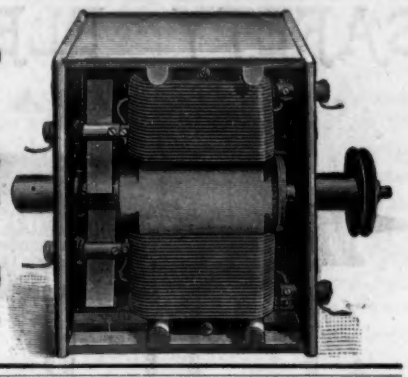

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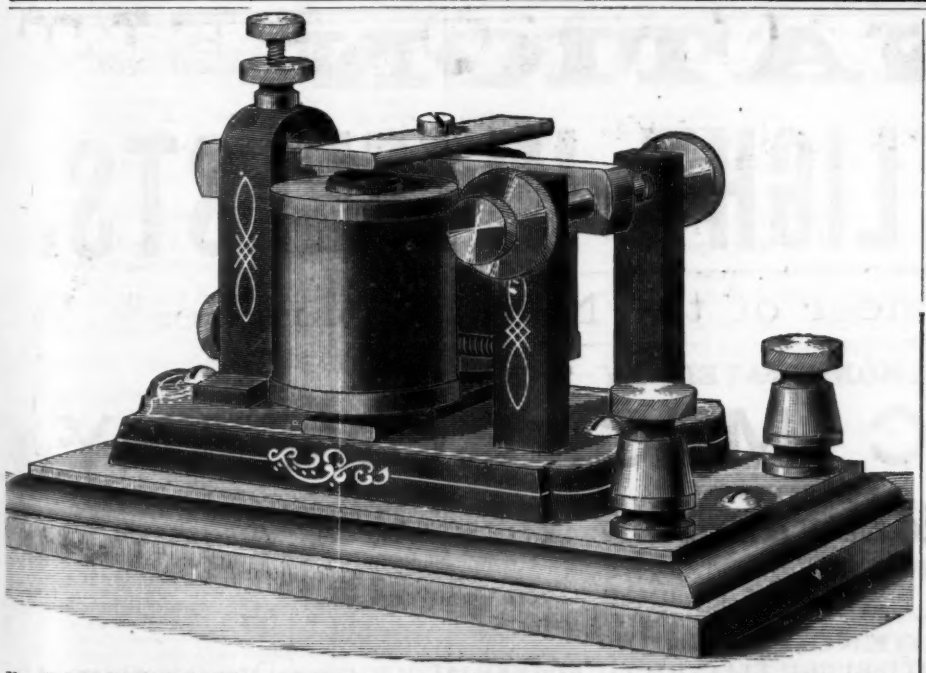

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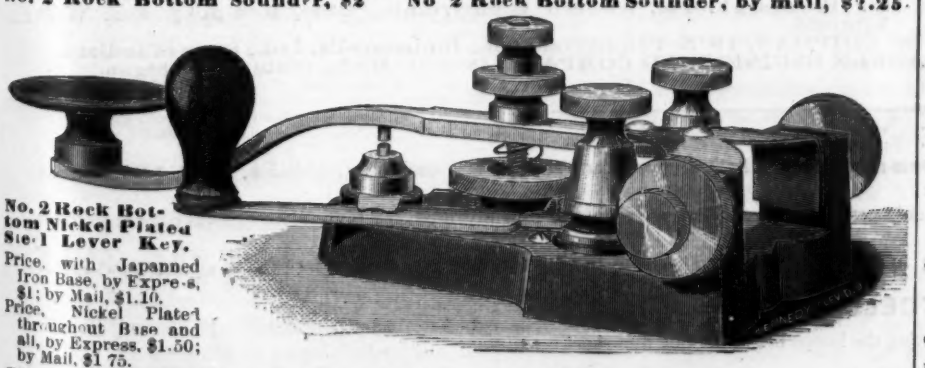

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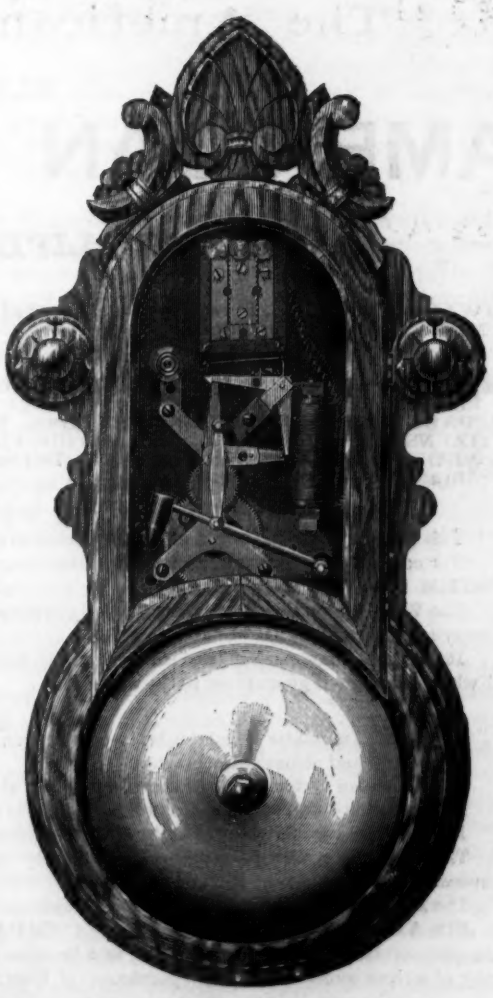

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